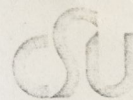




Department of Fishery and Wildlife Biology



Colorado State University
Fort Collins, Colorado
80523

February 23, 1982

Dr. Brian Coad
Department of Ichthyology
National Museum of Canada
Ottawa, Ontario, Canada K1A 0M8

Dear Brian:

Enclosed is a copy of our Arabian fish paper. Al Kahem will select a series of specimens to send to you for deposition in the NMC collections. You will perhaps chuckle when you read of our holotypes and paratypes in the CSU collection. I agree this is somewhat of a joke that would shock most museum taxonomists.

Dr. Krupp of Mainz, Germany, is also submitting a paper on Arabian fishes for volume 5 of the Fauna of Saudi Arabia series. We haven't seen his MS but in a letter he mentioned the collections he examined contained 59 Cyprinion sp. (probably our C. mhalensis) and 24 Garra sp. (probably the undescribed species we discuss on the basis of a single specimen). I would appreciate any comments you have. I feel a bit "shaky" on the phylogenetic interpretation of Arabian Barbus.

I received several reprints from the NMC including your description of Pseudophoxinus persidis and the Afghanistan check list. I recall that Dr. Steinitz of Isreal sent me a trout specimen from the Bamean River, Afghanistan more than 20 years ago to identify. He was preparing a paper on Afghanistan collections at the time. Evidently he died before completing the work.

Your new species of Pseudophoxinus is widely distributed. It should have appeared in the collections used by Saadati. Have you noticed any such specimens that Saadati overlooked? Did you examine the "Phoxinellus" sp. described by Saadati? As I recall in Armantrout's thesis he thought the species had been previously described as Rutilus tricolor (or some such name).

Have you examined the Iranian "Alburnus" material -- capito, atropatenea, the Rezayieh basin specimens resembling L. gaderanis, the "unknown Alburnus" from the Namek basin, etc.? Evidently, Leuciscus and Alburnus, as used by Saadati, need revision. Have you come up with workable generic diagnoses?

FRESHWATER FISHES OF ARABIA

by H. F. Alkahem and R. J. Behnke
Department of Fishery and Wildlife Biology
Colorado State University
Fort Collins, Colorado 80523
U.S.A.

This work reports on the first comprehensive scientific collection of freshwater fishes from Saudi Arabia. Two new species, Cyprinion mhalensis and Barbus nemus, are described. A single species is characterized that probably represents a new species of Garra. Specimens of the genus Mirogrex represent the first record of this genus beyond the confines of the Jordan River basin. The first record of a non-native fish (Gambusia affinis) from Saudi Arabia is also given and several new distributions are recorded.

Comprehensive appraisal of geological, geographical and climatic events correlated with zoogeographical evidence and interpretation of degree of divergence in living species is utilized to provide an interpretation of factors explaining the present distribution and taxonomy of freshwater fishes.

Cultural and religious bases are presented as a rationale for preserving and protecting the native fishes of Arabia as a part of Arabian biological heritage.

INTRODUCTION

The Arabian Peninsula consists of several nations. The largest is the Kingdom of Saudi Arabia, which occupies some four-fifths of the Arabian Peninsula (= Arabia).

During the early Cenozoic, Arabia was part of a continuous African-Asiatic land mass. From the middle to the end of this era, an erosional process increased as a result of land movements causing an opening of the Arabian Gulf at the strait of Hormuz, connecting the Gulf to the Indian Ocean (Abualula 1975). During the Miocene, the Red Sea was part of the Mediterranean Sea or the Tethys Sea. At that time the Red Sea was separated from the Indian Ocean, but in the beginning of the Pliocene, the land surface was raised, as a result of which the Red Sea became isolated from the Mediterranean-Tethys Sea and the Strait of Babalmandeb was formed, connecting the Red Sea to the Indian Ocean.

Freshwater fishes are the best evidence of past land connections with Arabia serving as a bridge between northeast Africa and Asia, because primary freshwater fishes (mainly of order Cypriniformes) are restricted to freshwater and can only disperse by freshwater routes.

Little is known of Arabian freshwater fishes. Berg's (1934) map of fish zoogeography has a question mark (?) on the Arabian Peninsula. The literature of freshwater fishes of Arabia is very sparse. Boulenger (1887) described a new species of cyprinid fish from Muscat on the east coast of Arabia. Trewavas (1941) described three new species of cyprinids based on collections from southwest Arabia. Fowler and Steinitz (1956) described a new cyprinid species from Oman. The most comprehensive work regarding freshwater fishes of the Arabian Peninsula with the first mention

of freshwater fish from Saudi Arabia is the study of Banister and Clarke (1975). They recognized nine species of three genera of the "minnow" family Cyprinidae and one species of the "top minnow" family Cyprinodontidae. All except one of the cyprinid species are considered endemic to Arabia, indicating the long isolation of most of Arabia from direct freshwater access routes of dispersal.

Our collections made in 1977 and 1981, although restricted to Saudi Arabia, represent the most extensive sampling of freshwater fishes yet made on the Arabian Peninsula. We found all of the species described by Banister and Clarke from Saudi Arabia plus a new species of Cyprinion, a new species of Barbus, an undescribed species of Garra, and a species of undetermined status of Mirogrex. The American mosquito fish, Gambusia affinis (Poeciliidae), is the first Arabian record of a non-native freshwater fish.

It is important that further studies be initiated soon to increase the knowledge of the freshwater fish fauna before industrial and agricultural development occur on a large scale and inalterably change or destroy the fragile freshwater habitats. Groundwater pumping has already dried springs in some areas. Water development projects will dramatically alter much of the present aquatic habitats and exotic fish species will likely be introduced. Unless the present fish fauna is studied and documented, species may become extinct before they were known to exist.

Figure 1 illustrates six separate drainage basins based on the topography of the Peninsula. It is assumed that during major pluvial periods, all drainage within any one of the present internal basins would have been interconnected, allowing the opportunity for dispersal of fishes throughout a basin.

METHODS AND MATERIALS

Fishes were collected by means of seines and hook and line. Fish specimens were immediately preserved in 10% formalin solution and later transferred to 40% isopropyl alcohol. Samples were collected in 1977 and 1981 from Almhaleh, a permanent stream southeast of Abha City, Alhufuf, Alkharj, Khaybar, and Wadi Hediah (west of Khaybar City). Other drainages such as Tabuk, Alula, Aljawf and Al-aflaj were visited, but no evidence of fish was found.

About 600 specimens were collected. The most common and ubiquitous species, Aphanius dispar, made up about two-thirds of the total number of specimens.

Measurements and counts on specimens were made according to the standard methods of Hubbs and Lagler (1947) with some particular modifications in accordance with Banister and Clarke (1975). Specimens are presently maintained in fish collections in the Department of Fishery and Wildlife Biology, Colorado State University, Fort Collins, Colorado, USA.

The following abbreviations for counts and measurements are used in the manuscript:

TL	Total Length
SL	Standard Length
BD	Body Depth
HL	Head Length
OL	Orbit Length
UJL	Upper Jaw Length, measured from barbel to short-tip
DO	Dorsal Origin to short-tip
DFBL	Dorsal Fin Basal Length
DFDL	Dorsal Fin Depressed Length
CPD	Caudal Peduncle least Depth
CPL	Caudal Penduncle Length
IL	Intestine Length
AFDL	Anal Fin Depressed Length
BL	Barbel Length

D	Number of Dorsal Fin Rays (Roman numeral for unbranched rays, Arabic numeral for branched rays)
A	Anal Fin Rays
P	Pectoral Fin Rays
V	Ventral or Pelvic Fin Rays
L.L.	Scales count in Lateral Line
PFL	Pectoral Fin Length
AFBL	Anal Fin Basal Length
Snt.L	Snout Length
IOW	Interorbital Width
LJL	Lower Jaw Length
DSL	Dorsal Spine Length (= longest unbranched spine)

PREVIOUS STUDIES OF FRESHWATER FISHES OF ARABIA

The first description in the literature of freshwater fish from Arabia was by Boulenger (1887) who described a new species, Scaphiodon muscatensis, from Muscat. Berg (1949) synonymized Scaphiodon muscatensis with Cyprinion microphthalmum, a widespread species in Iran and Pakistan. Hora (1921) described a new species, Garra arabica, from Lahej, near Aden, South Yemen. Trewavas (1941) described three new species: Barbus arabicus, Garra tibanica, and Garra brittoni and recorded the occurrence of Aphanius dispar (Cyprinodontidae) from Yemen, based on collections made by The British Museum of Natural History Expedition to Southwest Arabia, 1937-38. Fowler and Steinitz (1956) described a new species, Garra barreimiae, from Oman.

The most recent and comprehensive publication on the Arabian freshwater fishes is by Banister and Clarke (1975) in which collections from Saudi Arabia are mentioned for the first time. They list nine species: eight cyprinids and one cyprinodont: four of the cyprinids are described for the first time--Barbus apoensis, Barbus exulatus, Cyprinion acinaces and Garra longipinnis.

Van Couvering (1977) mentioned fossil cichlids (family Cichlidae)

and Barbus-like material of unknown age from Ad Darb, Red Sea coast. Brown (1970) mentioned a Miocene fossil of Barbus in the Jizan basin near Tihama north of the Yemen boundary.

Figures 2A,B illustrate the known distribution of Arabian freshwater fishes based on previous literature and the results of our study.

FAMILY CYPRINIDAE

Upper jaw margined, as a rule. Barbels if present not more than 2 pair (4 pairs only in Gobiobotia [Berg 1949]). Swimbladder usually free, not enclosed in a bony capsule. Body scaled. About 275 genera in the freshwaters of the world except South America, Australia and Madagascar (Nelson 1976). More species than any family of vertebrates (about 2,000 species). The first 2, 3 or 4 rays in the dorsal and the anal fins unbranched. Most anterior unbranched rays typically rudimentary. No adipose fin. Mouth toothless, head scaleless. Most species are small and some are very strikingly colored.

Genus Barbus Cuvier, 1817

Barbus Cuvier, 1817, Regne, anim. II, p. 192 (type: B. barbus).

Typically with two pairs of barbels, seldom one or none. Mouth inferior, lips well developed. Pharyngeal teeth are 2.3.5-5.3.2 or 2.3.4-4.3.2. Peritoneum white or dark brown. Anal fin with 5 or 6 branched rays.

Taxonomic Outline

A most difficult and confusing problem of ichthyology is the classification of the African, Asiatic and European fish of the genus Barbus (Myers 1960). Barbus contain many phyletic lines of greater or

lesser extent and the aggregate transcends the limit of what the majority of ichthyologists would consider a single genus (Myers op. cit.). Günther suggested it is necessary to subdivide several sections of the genus purely on geographical ground before he would handle the classification expeditiously (Myers op. cit.). Boulenger divided Barbus into several sections, based on scale characters and it seems possible that these sections are of phylogenetic importance (Myers op. cit.).

Northeast African Barbus (large scale) and a group of large-scaled Near Eastern Barbus are the logical ancestor types of Arabian Barbus species.

Distribution

Barbus is widespread in temperate or tropical parts of Europe, Asia, and Africa. The range of the genus in Arabia is the coastal drainages of the Red and Arabian seas and a new record from our collections is the occurrence of B. apoensis and B. nemus in the Wadi Almhaleh draining to the Ar Rub'al Khali internal basin. There is no record of Barbus from Arabian Gulf drainages.

Several Barbus species occur in the Tigres-Euphrates basin, and B. barbulus and B. luteus are known from the Mond River drainage of Iran. No other gulf drainages were found to have Barbus (Saadati 1977). The number of Barbus species in Arabia is yet to be determined. Four species are recognized by us. Barbus apoensis is known from the Wadi Almhaleh southeast of Abha, the Wadi Turabah near Ataf and the Wadi Adamah, 19° 53' N, 41° 57' E. Barbus exulatus is known from several localities in the Wadi Hadhramaut and Wadi Maran in East Yemen. Barbus arabicus is widespread in the southwestern part of Arabia. Barbus nemus is known from the Wadi Almhaleh, southeast of Abha City and Khaybar drainages (Figure 2).

Barbus apoensis Banister and Clarke, 1975

Barbus apoensis Banister, K. and M. A. Clarke. 1975. Jour. Oman Studies, Spec. Rep. (Sci. Results, Oman Flora and Fauna Survey): p. 113.

D IV 10, A III 6, L. L. 31

Specimen Examined

One specimen, 274 mm SL, was caught July 1977 from Wadi Almhaleh, a permanent stream southeast of Abha City.

Description

The shape of the body can be seen in Figure 3. This species was described by Banister and Clark (1975) from a permanent stream near Khamis Mushayt and other localities in Saudi Arabia. They based their description on 12 specimens. According to their description,

"the greatest depth of the body occurs about halfway between the origin of the pectoral fin and the origin of the dorsal fin. A pronounced nuchal hump is present and the dorsal profile of the head is concave. The mouth is terminal and has marked upwardly directed gape. The posterior barbels are small. The eyes are lateral and slightly protuberant. The lips are continuous. There are 4 unbranched rays in the dorsal fin. The last one is thickened into an unserrated, smooth spine. The spine is not strongly ossified and is flexible in its distal third. There are 10 branched dorsal rays. The lateral line scales number 26-29. Twelve scales encircle the least circumference of the caudal peduncle. There are 2.3.5-5.3.2 pharyngeal teeth. The gill rakers are strong, curved and widely spaced. They decrease rapidly in size from the angle of the gill arch forwards. On the lower limb of the first gill arch there are 6-9 gill rakers."

The specimen examined from the Wadi Almhaleh shows the characters described above except for some differences noted, such as 31 scales in the lateral line instead of 26-29. Ten scales encircle the least circumference of the caudal peduncle. The lateral line is straight. Proportional measurements of Barbus apoensis expressed in thousandths of the standard length are presented in Table 1.

Table 1. Proportional Measurements of Barbus apoensis Expressed in Thousandths of the Standard Length.

Measurements	
SL	274
BD	307
HL	321
OL	051
UJL	095
DO	544
DFBL	153
DFDL	237
BL	036
CPD	109
CPL	164

Coloration

Live colors are golden with olive fins. Preserved specimen is pale-yellow below and gray-brown above.

Distribution

This species is known from Wadi Almhaleh, southeast of Abha, the Wadi's Turabah, Adamah, and Hediah, Saudi Arabia (Figure 2).

Relationships

Barbus apoensis appears to have closer relationships to B. nemus than to any species outside of Arabia. A group of three apparently closely related Near Eastern species of Barbus, B. canis, B. chantrei, and B. luteus, suggests a common progenitor for them as well as the Arabian species. The three Near Eastern and the two Arabian species share a set of characters differentiating them from other Near Eastern Barbus-- 6 branched anal rays (vs. 5), few gillrakers, typically 10 branched

dorsal rays (vs. typically 8) and low lateral line scale counts (23 to 38 vs. 40 or more). B. canis and B. chantreii have two pairs of barbels and a serrated dorsal spine. B. luteus, B. apoensis and B. nemus have a single pair of barbels and an unserrated dorsal spine. B. exulatus and B. arabicus have two pairs of barbels and an unserrated dorsal spine. B. exulatus typically has 9 branched dorsal rays and B. arabicus 8. B. canis is endemic to the Jordan River basin, B. chantreii to the Orontes basin, and B. luteus is more widely distributed in the Tigris-Euphrates and Mond river basins.

Barbus exulatus Banister and Clarke, 1975

B. exulatus Banister, K. and M. A. Clarke. 1975. Jour. Oman Studies, Spec. Rep. (Sci. Results, Oman Flora and Fauna Survey): p. 116.

The description of this species was based on several localities associated with the Wadi Hadhramaut and Wadi Maran, East Yemen. According to the description, the body is slightly compressed and the dorsal profile is arched. Two pairs of barbels are present. There are 4 unbranched and 7-9 branched dorsal rays. There are 3 unbranched and 6 branched anal rays. The lateral line scales count ranges from 24-28. Gill rakers are short and widely spaced. Their count on the lower limb of the first gill arch ranges from 6-9.

Barbus arabicus Trewavas, 1941

Barbus arabicus Trewavas, 1941, British Museum (Natural History) expedition to South-West Arabia 1937-8, 1(3):14.

One fish, 250mm SL, from Wadi Jizan Dam, near Jizan City, collected by Dr. Naser Alassgah, March, 1981, was examined.

Description

The type locality of this species is unknown. The holotype was purchase at a market at Sa'á, North Yemen. In addition, Banister and Clarke (1975) recorded it from several localities of south and southwestern Arabia (Figure 2). According to their description:

"the body is slim and graceful. The snouth obtusely pointed in lateral view. The mouth is subterminal. There are two long pairs of barbels. The eyes are small and superolateral in position. The dorsal fin has 4 unbranched rays (the last of which is ossified into a smooth straight spine) and 7-9 branched rays. The anal fin has three unbranched rays and five branched rays. There are 25 to 32 scales in the later line. There are 12 scales around the leased circumference of the caudal peduncle. The gill rakers number 9-13 on the lower limb of the first gill arch."

The specimen examined from Wadi Jizan Dam shows the characters described above plus small protuberances on a few rakers of the first gill arch. The later character has not been mentioned before. The proportional measurements of the examined fish expressed in thousandths of the standard length are:

BD = 288, HL = 256, OL = 36, UJL = 68, DO = 480, DFBL = 136, DFDL = 152, BL (posterior) = 88, CPD = 136, and CPL = 172.

Distribution

This species seems to be widespread in southwestern and southern coastal drainages (Figure 2).

Relationships

Barbus arabicus can be distinguished from all other Arabian Barbus on the basis of five branched rays in the anal fin. Trewavas (1941) considered this species to be more closely related to some Indian species and to Barbus canis than to any of the African Barbus. However, Barbus

canis has 6 branched rays in the anal fin, an important difference between B. arabicus and B. canis. Banister and Clarke (1975) aligned Barbus arabicus with the species of Barbus in northeastern Africa--the Barbus intermedius complex because of the following reasons: The morphological similarity between the species, i.e. the possession of the same type of scale striation (more or less parallel), a caudal peduncle longer than deep, and a well ossified straight dorsal spine. The phenotypic variability of Barbus arabicus parallels Barbus intermedius (Banister 1974). The distribution of Barbus arabicus, i.e. in the southern part of Arabia just across the Red Sea from Barbus intermedius, suggests an African origin (Banister and Clarke 1975).

It is likely that the B. intermedius complex of northeast Africa represents an earlier branch of the phyletic line giving rise to the three near Eastern Barbus species discussed previously (lower numbers of dorsal and anal rays are probably primitive characters). B. arabicus typically has 8 branched dorsal rays and the typical number of these rays in B. exulatus is 9. B. arabicus and B. exulatus both have two pairs of barbels. B. arabicus differs from other Arabian Barbus by having 5 branched anal rays.

Barbus nemus, new species

Material Examined

Holotype, no. 3 in Arabian fish collection, Colorado State University, standard length 81 mm, collected July 1977 from Wadi Almhaleh, a permanent stream southeast of Abha City. Paratype, no. 3A. One specimen, standard length 78 mm, collected from the same locality and two specimens (no. 3B), SL 35, 41 mm, collected from Ain Aljmyma, Khaybar, Saudi Arabia.

Description

(Holotype plus range)- Dorsal fin branched rays 10; anal fin branched rays, 6; lateral line scales 29 (23-29); gill rakers on the anterior side of the first gill arch 9 (7-10). Pectoral fin rays 16(12-16).

The shape of the body can be seen in Figure 4. The head is short and obtuse; mouth is terminal. Anterior edge of the lower jaw is curved, but without blade. The mouth does not display a markedly upward directed gape. The dorsal profile of the head is not concave. There is one pair of small barbels. No tubercles observed. Peritoneum, dark-brown. Caudal peduncle short and narrow. The caudal fin is forked. The stomach is muscular. The airbladder is bipartite, the posterior chamber is larger and slightly narrower than the anterior one. Gill rakers are few, short, thin and slightly curved. Proportional measurements of Barbus nemus are presented in Table 2.

Table 2. Proportional measurements of Barbus nemus expressed in thousandths of the standard length.

Measurements (N-4)	Holotype	Mean	Range
SL	81	58.75	35-81
BD	272	254	229-272
HL	309	338	309-366
OL	074	097	074-122
UJL	099	117	099-143
DO	556	533	514-556
DFBL	185	213	185-228
DFDL	247	299	247-321
BL	049	058	149-073
CPD	123	128	122-142
CPL	209	187	167-209
AFDL	185	170	154-185
IL* (n=2)	2.05	1.76	1.48-2.05

*Actual ratio of intestine length to standard length.

Coloration

Alcohol preserved specimens are brownish dorsally and yellow-brown below the lateral line. No spots on the middle of the flank.

Distribution

This species was collected together with B. apoensis in the Wadi Almhaleh. Thus, the two species occur in sympatry. The 1981 collections extended the range of the species to a spring (Ain Aljyma) northwest of Khaybar City (Figure 2).

Etymology

The specific name is derived from the Latin word for pasture and describes the pastoral setting of the type locality.

Relationships

Barbus nemus resembles Barbus apoensis in the possession of 6 branched rays in the anal fin, 10 branched rays in the dorsal fin, and one pair of barbels. It differs from B. apoensis in the following characters: the dorsal profile of the head is less concave, absence of a pronounced nuchal hump, type of scale striation, and in the absence of a pronounced gape of the mouth.

All of the four known Arabian species of Barbus appear to be part of a phyletic section of the genus characterized by low scale counts and few gillrakers, originating and speciating in the northeast Africa - Near East region. On the basis of the present state of knowledge, any attempt to delineate relationships and branching points, associating Arabian species to other species would be highly speculative. The number of branched anal and dorsal rays and distribution patterns suggest B. nemus

and B. apoensis are sister species originating from a B. canis-B. luteus type of ancestor invading from the north (Jordan River) or east (Tigris-Euphrates or Mond basins). Barbus arabicus and B. exulatus, with fewer dorsal rays, two pair of barbels, and a more southern distribution, appear to represent sister species derived from the B. intermedius complex of northeast Africa.

Genus Cyprinion Heckel

Cyprinion Heckel, 1843, *Russgger, Reisen*, 1, p. 1015, 1065 (type: C. macrostomus).

Fishes of moderate size; scales of moderate size; dorsal fin with an osseous and serrated spine and numerous branched rays; mouth inferior; pharyngeal teeth 2.3.4-4.3.2; one pair of barbels; peritoneum black; alimentary canal long and convoluted; air bladder bipartite or tripartite; seven branched anal rays.

A new generic character discovered by Saadati (1977) is a dorsal ridge derived from fused interneural bones.

Distribution

This genus is widespread in west Pakistan, Afghanistan, Arabia, Iran Iraq and Syria. It occurs in all drainages to the Indian Ocean, and in tributaries to the Arabian Gulf.

In Arabia, based on Banister and Clarke's studies (1975), Cyprinion occurs in the coastal drainages and in the Ar-Rub'al-Khali Basin.

In Saudi Arabia, based on our collections, the genus occurs in the Wadi Almhaleh of the Ar-Rub'al-Khali Basin and the Red Sea drainages. Our collections consist of 55 specimens of Cyprinion from different springs .

and streams in Khaybar, N. Al-Hijaz and Wadi Almhaleh southeast of Abha City. Cyprinion acinaces was collected from Khaybar springs. C. mhalensis was collected from Wadi Almhaleh in the Asir highlands and an unnamed spring in Khaybar City (this spring was dry in 1981). C. mhalensis is differentiated from any described species by a long intestine (about 5 times the standard length), number of scales (40-43) and other morphological characters.

Taxonomic Outline

The systematic status of the species of Cyprinion is still not well delineated. The problem is that there appears to be no clear cut difference between species with 10 branched dorsal rays. Until 1949 about fifteen species of Cyprinion were commonly recognized (Saadati 1977). Berg (1949) revised the genus and recognized only six species. The species recognized by Berg are: C. microphthalmum, C. macrostomum (Tigris-Euphrates Basin), C. irregulare, C. watsoni, C. milesi (Indian Ocean and Gulf drainages) and C. tenuiradius.

Mirza (1969) synonymized Cyprinion irregulare with Cyprinion watsoni. He recognized three species in Pakistan, C. watsoni distinguished by having an arched mouth, a conspicuous scaleless ridge on the back, bipartite air bladder, and the length of the alimentary canal about three times the total body length. C. milesi was distinguished by having a longer head and oblique mouth. C. microphthalmum was distinguished by having a transverse mouth, tripartite air bladder and the length of the alimentary canal more than 3.5 times the total body length.

Saadati (1977) indicated that the condition of the dorsal spine is highly variable in Iranian Cyprinion. Stout, weak and intermediate spines were found in a single sample.

Prior to the publication of Banister and Clarke's work (1975), only Cyprinion microphthalmum was known from Arabia. Banister and Clarke (1975) described Cyprinion acinaces as a new species from Arabia. Our collections contain an additional species of Cyprinion.

The species described in Oman as Scaphiodon muscatensis by Boulenger (1887) and considered as C. microphthalmum by Berg (1949) is more likely Cyprinion watsoni, according to the revision of Mirza (1969). In characterization and recognition of C. watsoni, C. microphthalmum, and C. milesi must be considered as doubtful. These species (or subspecies) do form a phyletic line of the genus characterized by 10 to 12 branched dorsal rays and a conspicuous scaleless dorsal ridge anterior to the dorsal fin.

All known Arabian species are derived from this species group, indigenous to the Indian Ocean and Arabian Gulf drainages of Iran and Pakistan. We follow Saadati (1977) who identified Iranian specimens from Gulf drainages as C. watsoni, based on Mirza's (1969) revision.

Cyprinion acinaces Banister and Clarke, 1975

Cyprinion acinaces Banister, K. and M. Clarke. 1975. Jour. Oman Studies, Spec. Rep. (Sci. Results. Oman Flora and Fauna Survey): p. 123.

Material Examined

20 specimens collected July, 1977, from Ain Al-Bhair, Khaybar, N. Al-Hijaz.
14 specimens collected July, 1977, from Ain Salaliem, Khaybar, N. Al-Hijaz.
12 specimens collected July, 1977, from Ain Ali (Abowashia), Khaybar,
N. Al-Hijaz.

Description

The shape of the body can be seen in Figure 5. According to Banister

and Clarke's (1975) description,

"the mouth is ventral. The anterior edge of the lower jaw is gently curved and covered with a sharp-edged horny sheath. Barbels are short. Tubercles are present on the snout and interorbital region of some specimens. The eyes are lateral and visible in ventral view. The peritoneum is black. The skin between the pelvic fin base is fatty, thickened and papillose. The development of the thickened skin varies considerably. It is a heart-shaped patch of skin, although the papillae are continued onto the pelvic fin rays. At the other extreme, there are three flaps: there is a median, posteriorly directed flap laying between the pelvic fin bases flanked on each side by a smaller flap which may cover the bases of the pelvic fins. The dorsal fin has four unbranched rays and 11-12 branched rays. The last unbranched ray is ossified into a long straight spine with a strongly serrated posterior face. The anal fin has three unbranched rays and seven branched rays.

In the lateral line there are 34-39 scales. Pharyngeal teeth number 2.3.4-4.3.2. Gill rakers are widely spaced, short, thin and slightly curved. On the lower limb of the first gill arch there are 8-12 gill rakers."

Specimens of this species possess the pronounced, scaleless bony ridge between the occiput and the origin of the dorsal fin similar to that seen in Cyprinion watsoni. The head is elongated. Mouth is of variable shape, i.e., ventral, transverse, oblique, terminal or subterminal. In other specimens the mouth contains a sharp curved blade in the lower jaw, while in yet others the cornified blade is weakly developed. The lateral line is straight in some specimens, curved in others. Lateral line scale counts range from 32 to 38.

There are 2-4 scales between lateral line and the pelvic fin. There are 15-16 scales around the least circumference of the caudal peduncle. There are 5-8 scales above the lateral line. In some specimens, there are no fatty-thickened papillose skin between the bases of the pelvic fin, but other specimens do have this structure. Brown spots above the lateral line present in young disappear in adults. There are tubercles in

some male specimens. The stomach is well developed. The intestine length is from 2.44 to 3.75 times the standard length. The gas bladder has two chambers. Its posterior chamber is longer and slightly narrower than the anterior one. There are nine rays in the pelvic fin. The pectoral fin has 16 rays. Pectoral fins do not reach pelvic fins. Gill rakers on the first gill arch are short, strong and curved, their count ranges from 12-15. There are 20-25 gill rakers on the posterior side of the first gill arch. There are 23-28 gill rakers on the anterior side of the second gill arch. The caudal peduncle is narrow and short. The caudal fin is forked. The anus is immediately in front of the anal fin. Proportional measurements are presented in Table 3.

Coloration

Fresh specimens are gray dorsally, silver laterally, and silver ventrally. Preserved specimens are gray-brown dorsally, silver-gray or white-gray laterally. Dark brown spots are present above the lateral line in young specimens. These spots become obscure in older specimens.

Distribution

Previously, this species was known only from Wadi Hadhramaut and in a stream at (or near) Ta'if, Saudi Arabia. Our collections extend the range to Khaybar drainages in Saudi Arabia (Figure 2) and suggest that the Ta'if specimens may be C. mhalensis and not acinaces.

Relationships

The only Cyprinion with a strongly serrated dorsal spine is Cyprinion macrostomum, but Cyprinion acinaces can be distinguished by having fewer branched rays in the dorsal fin (11-12 vs. 13-15, mostly 14), fewer branched rays in the anal fin (7 vs. 8), fewer scales (32-38 vs.

38-43). Banister and Clarke (1975) were unsure of the affinities of C. acinaces. In our opinion, the presence of the conspicuous scaleless dorsal ridge and general agreement in other characters suggest the closest relationships of Cyprinion acinaces to Cyprinion watsoni. Arabian specimens of C. acinaces and Iranian specimens identified as C. watsoni by Saadati (1977) are relatively similar in general appearance and taxonomic characters. The dorsal spine is typically stouter and more strongly serrated in C. acinaces than in C. watsoni, C. acinaces typically has 11 or 12 branched dorsal rays, vs. typically 10 in watsoni. Separation from a common ancestral stem may have occurred during the Pleistocene.

Cyprinion mhalensis, new species

D-IV-III 10, A III-7, L. L. 40-43.

Material Examined

Holotype, no. 1 in collection of Arabian fishes, Department of Fishery and Wildlife Biology, Colorado State University, standard length, 141 mm, collected July 1977 from Wadi (Valley) Almhaleh near Abha City (permanent stream). Paratypes (no. 2), seven specimens collected from the same locality.

Description:

(Holotype plus range).—Dorsal-fin branched rays 10; anal fin rays 7; pectoral fin rays 17 (14-17); pelvic fin rays 9 (8-9); lateral line scales 43 (40-43); gill rakers on the anterior side of the first gill arch 16 (11-16). The shape of the body can be seen in Figure 6. The mouth is transverse, subterminal, oblique or ventral. The anterior edge of the lower jaw is curved, covered with a well developed blade.

The blade in some specimens is not well developed, especially in small fish. The snout is blunt and short. The interorbital space is flat. There is one small pair of barbels. Tubercles are absent on the snout and interorbital region of the specimens examined. There is a well developed bony ridge from the occiput to dorsal fin origin. The degree of the development of the bony ridge is more conspicuous in large specimens. Peritoneum is sooty black. No scales on ventral side. The eyes are lateral and visible in ventral view. The standard length is 3.8 times longer than the body depth. The head length is 3.7 times longer than the orbit. The standard length is 3.8 times longer than the head. The caudal peduncle length is 18% of the standard length. The caudal peduncle depth is 10% of the standard length. The stomach is well developed and muscular. The intestine is very long in one specimen; its length from the end of the stomach is 7 times the standard length, while in other specimens the intestine is about 4 to 6 times the standard length. The air bladder is bipartite, its posterior chamber is longer and slightly more narrow than the anterior one.

There are 3 or 4 unbranched rays and 10 branched rays in the dorsal fin (last two counted as one). The first unbranched ray is ossified almost to the tip and strongly serrated all along the ossified segment. The dorsal fin origin is slightly anterior to the origin of the ventral fin. The dorsal spine length is shorter than the body depth.

There are 3 or 4 unbranched anal fin rays and 7 branched rays. The anal fin when laid flat does not reach the caudal fin. The anus is immediately in front of the anal fin.

Squamation. There are 40-43 (41.4) scales in the lateral line. The lateral line is normally straight to the middle of the caudal peduncle,

but in some specimens it is slightly curved. No scales on the bony dorsal ridge.

Gill Rakers. Gill rakers are short, slightly curved and thin. On the anterior side of the first gill arch there are 11-16 (13.1) gill rakers. On the posterior side of the first gill arch there are 21-32 (24.4) gill rakers. On the anterior side of the second gill arch there are 22-31 (26) gill rakers. Proportional measurements are given in Table 3.

Coloration

Preserved specimens in alcohol are gray-brown dorsally and silver-gray below the lateral line. Dark brown patches are present above the lateral line in some specimens especially young fish. These patches disappear in mature fishes.

Distribution

This species was collected only from the Wadi Almhaleh, tributary to the Wadi Bishah of the Rub'al Khali basin southeast of Abha City (Figure 2). Banister and Clarke (1975) described four specimens of C. acinaces collected near Ta'if (probably in Rub'al khali basin) and three specimens listed as "Cyprinion incertae sedis" from a tributary to the Wadi Bishah (probably the Wadi Mhaleh) of the Rub al Khali basin. These seven specimens have 39 to 41 scales and six have 10 branched dorsal rays and one has 11. We believe these seven specimens discussed by Banister and Clarke are C. mhalensis. On the basis of present information, C. mhalensis is known only from the Rub'al Khali basin and C. acinaces from western and southern coastal drainages.

Etymology

The specific name is named for type locality, Wadi Almhaleh.

Relationships

Cyprinion mhalensis can be distinguished from C. acinaces in general appearance, fewer branched rays in the dorsal fin (10 vs. 12) and more scales in the lateral line (40-43 vs. 32-38). Other distinctions between C. mhalensis and C. acinaces include the greater relative length of the intestine in C. mhalensis. All Arabian Cyprinion are likely derived from an ancestor of Cyprinion watsoni and the scaleless bony ridge indicates such affinities. C. mhalensis and C. acinaces are divergent from C. watsoni by having a stouter, more strongly serrated dorsal spine. There is no sound basis for discussing primitive vs. derived character states in an attempt to construct phyletic branching points in Cyprinion evolution. C. acinaces and C. mhalensis may have diverged from a common ancestor in Arabia or be the result of separate ancestral crossings of the Arabian Gulf. Future collections may find drainages where acinaces and mhalensis have come into contact. If they maintain reproductive isolation in sympatry, there would be no doubt about the species status of mhalensis. If they hybridize to produce intermediate populations, subspecies status would more appropriate.

Unknown Cyprinion

One specimen of Cyprinion was collected from an unnamed spring in Khaybar City in 1977. When this habitat was revisited in 1981 the spring was dry. This specimen resembles Cyprinion mhalensis in the shape and the color of the body. It has the same number of dorsal and anal rays,

the same number of scales, and in the possession of a strongly serrated spine in the dorsal fin. The major distinction between this specimen and C. mhalensis is the greater relative length of the intestine in C. mhalensis (4.0-7.0 vs. 2.7) and the longer more narrow caudal peduncle in this specimen. The specimen might be an aberrant C. mhalensis or a subspecies of mhalensis or, perhaps, a new species. More specimens will be necessary before a decision can be made. Proportional measurements of this specimen are presented in Table 3.

Table 3. Proportional measurements of Cyprinion specimens expressed in thousandths of the standard length.

Measurements	<u>C. acinaces</u> (N=46)		<u>C. mhalensis</u> (N=8)			Unknown <u>Cyprinion</u> from Khaybar City
	\bar{X}	Range	Holotype	\bar{X}	Range	
SL	78.3	50-117	141	85.5	55-141	124
BD	291	250-341	262	264	237-345	202
HL	286	256-316	241	269	241-280	242
OL	075	060-100	049	076	049-098	065
UJL	076	055-091	064	075	065-091	065
DO	515	419-560	518	522	500-545	524
DFBL	229	205-263	191	199	180-218	202
DFDL	319	274-368	262	261	237-291	290
BL	050	028-083	035	039	028-055	024
CPD	105	083-125	099	103	093-127	064
CPL	170	145-200	163	178	148-206	194
AFDL	193	159-250	248	212	164-248	210
IL*	3.10	2.44-3.75	6.99	5.29	3.95-6.99	2.7

*Actual ratio of intestine length to standard length.

Cyprinion watsoni (Day)

Schaphiodon watsoni Day, 1872, Jour. Asiat. Soc., Bengal, XLI:
324 (India).

Saadati (1977) gave the characters of 48 specimens from Iranian Gulf drainage and other localities (Bumpur, Lut and Mashkel basins). According to Saadati's description, the dorsal fin has 4 unbranched and 9-11 (mostly 10) branched rays. There are 3 unbranched and 7 branched anal rays. The lateral line scales range from 34 to 42. There are 8-14 gill rakers on the anterior side of the first gill arch. The mouth shape is variable from transverse to arch shape. Mirza (1969) mentioned that this species has^a_λ bipartite air bladder and its intestine length is about 3 times the total length. From C. mhalensis, C. watsoni differs in general morphology, shorter intestine, fewer scales and by a weaker dorsal spine. From C. acinaces, C. watsoni differs in general appearance, fewer branched rays in the dorsal fin (10 vs. 12) and a weaker dorsal spine.

The species described in Oman as Schaphiodon muscatensis by Boulenger (1887) and considered as C. microphthalmum by Berg (1949) is more likely Cyprinion watsoni based on the presence of C. watsoni in all Iranian drainages to the Gulf. All Arabian Cyprinion appear to represent divergences in the Cyprinion watsoni species group. The species endemic to Arabia and C. watsoni in Oman are probably derived from successive crossings of the Gulf when lowered Pleistocene ocean levels created a freshwater environment in the Gulf as mentioned by Banister and Clarke (1975). There are no Cyprinion in Africa; thus we assume the ancestors of the endemic species migrated to the west coast of Arabia after freshwater connections to Africa had been lost. An alternative hypothesis is that freshwater connections to Africa may have been present when Cyprinion ancestors

arrived in western Arabia (when Garra migrated to Africa from Arabia and Barbus migrated from Africa to Arabia), but they were blocked from establishing representative populations in Africa because of competitive exclusion from Barbus.

Genus Garra Hmilton

Garra Hamilton, 1822, Fishes of the Ganges, Edinburg, p. 343, (type: Cyprinus lamta).

"Mouth transverse. Lips continuous covered with anterior and posterior labial folds. Jaws covered with horny sharp edge. Snout more or less rounded or slightly conical. Barbels generally four, sometimes two. Pharyngeal teeth in three closely set rows: the inner 5 or 4, the middle 4 or 3, the outer 3 or 2. The typical number is 2.4.5-5.4.2, scales of moderate size. Dorsal fin with 9 to 12 rays, 6 to 9 of which branched (II,6-III,9) originating in advance of pelvics. Anal fin short with 6 to 8 rays (I,5-III,5), pectoral fin with I-II, 17 rays. Lower lip modified into a suctorial disc with free anterior and posterior margins. Gill rakers widely set, short and few. Air bladder varies in form and extent." (Menon 1964).

Distribution

The genus Garra is widespread from South China and Borneo in the east, through Burma, India and Ceylon, Afghanistan, Iran, Syria and Arabia to Somaliland, Ethiopia, East Africa and then southward to Guinea through the Congo (Menon 1964).

Taxonomic Outline

The genus Garra was described by Hamilton in 1822 based on Cyprinus lamta. Heckel described several species under a new genus, Discognathus from Iraq, Syria, and Iran. Heckel described Discognathus fusiformes from Bombay and in 1846 recorded the occurrence of Discognathus in Ethiopia. Günther listed D. lamta, D. macrochir, D. variabilis, and

D. nasutus in his "Catalogue of Fishes in the British Museum" (Menon 1964). Günther, Playfair and Blanford referred to D. lamta specimens from Afghanistan, Arabia, and Ethiopia respectively (Menon 1964).

Berg (1949) revised this group and divided it into two genera, Garra (two pairs of barbels) and Discognathichthys (= Discognathus) (one pair of barbels). Berg also pointed out that the sucking disc in Discognathus is fused at the anterior margin, whereas it is free in Garra. Berg recognized two species of Discognathus: D. variabilis and D. rossica. Menon (1964) included Discognathus as a species group of Garra. Menon's arrangement of Garra is as follows:

- a) The variabilis group (= Discognathus) Garra variabilis (Heckel) and G. rossica (Nikolsky) are the only species in this group. Saadati (1977) found an undescribed species in Iran.
- b) Gotyla group.
- c) Tibanica group. This group involved seven complexes and 28 species.

According to Menon (1964), the Garra species of Arabia, Iraq, Iran and Syria belong to the "rufa" complex of the tibanica group which consists of G. rufa obtusa (Heckel) from Iraq and Iran and G. barreimiae Fowler and Steinitz, from Arabia (Saadati 1977).

Banister and Clarke (1975) recognized three species of Garra in Arabia:

- 1) Garra barreimiae Fowler and Steinitz, 1956.
- 2) Garra longipinnis Banister and Clarke, 1975
- 3) Garra tibanica Trewavas, 1941

They recognized two subspecies of G. barreimiae, Garra barreimiae barreimiae and Garra barreimiae shawkahensis. They agreed with Menon (1964) in

aligning G. barreimiae with G. rufa, which is widely spread between the Mediterranean and the Tigris-Euphrates System. They related G. longipinnis with G. barreimiae.

Our collections in 1977 from western Saudi Arabia contain Garra tibanica from the Wadi Almhaleh and from one spring in Khaybar City. Our collections in 1981 extended the range of the genus to Wadi Hediah to the west of Khaybar City and Alwastah, a village southwest of Almadinah (Figure 2).

Garra tibanica Trewavas, 1941

Discognathus lamta: Playfair, 1870, Proc. Zool. Soc., London:85
(not Hamilton, 1822).

Garra tibanica Trewavas, 1941, British Museum (Natural History)
Expedition to southwest Arabia 1937-8, I(3):8.

Garra brittoni Trewavas, 1941, British Museum (Natural History)
Expedition to southwest Arabia 1937-8, I(3):11.
D III 7, A III 5, L. L. 30-36, P. 14-16, v. 8-9.

Materials Examined

- a. Two specimens, 73-86 mm SL from Wadi Almhaleh southeast of Abha City.
- b. Two fish, 38-46 mm SL from a spring in Khaybar, North Al-Hijaz.

Description

Banister and Clarke (1975) listed this species from different localities in Arabia (Figure 2). They based their description on 93 specimens, 46-110 mm SL. According to their description,

"The snout is blunt and distinctly wedge-shaped in dorsal view, pointed in side view. Most specimens possess horny tubercles on the sides and top of the snout. The mental disc is variable in shape. The anus is immediately in front of the anal fin. The dorsal fin has three or four unbranched rays; the last unbranched ray is not ossified. There are six,

seven, or eight branched rays. The anal fin has three unbranched rays and five branched rays. The lateral line has 30-36 scales. Around the least circumference of the caudal peduncle there are 12 to 20 scales. The pharyngeal teeth number 2.4.5-5.4.2 in all specimens examined. The gill rakers are short and widely spaced. On the lower limb of the first gill arch there are 6-17 gill rakers.

The four specimens collected in 1977 are similar to the description given by Banister and Clarke. According to our specimens the lateral line is straight, the caudal peduncle is elongate. Brown spots present on the 3rd, 4th, 5th, and 6th rays of the dorsal fin. There are two pairs of barbels. In some specimens tubercles are absent. In one specimen (75 mm SL) the mental disc width is 7 mm while its length is 6 mm. Proportional measurements are presented in Table 4.

Table 4. Proportional measurements of Garra tibanica, expressed in thousandths of standard length.

Measurements (N=4)	\bar{X}	Range
SL	60.75	38 - 86
BD	214	205-221
HL	218	218-289
OL	073	058-087
UJL	101	093-109
DO	508	476-526
BL	061	035-087
DFDL	226	209-239
DFBL	147	132-152
CPD	106	105-109
CPL	181	151-211

Coloration

The color is dark gray above, paler below. Dark spots at bases of the 3rd, 4th, 5th, 6th and 7th dorsal fin rays (branched).

Distribution

This species is widely distributed along the coastal drainages of west and southwestern Arabia. It occurs in Wadi Hadhramaut, Wadi Almhaleh southeast of Abha, a spring in Khaybar City, and Wadi Hediah (Figure 2).

Relationship

Garra tibanica shows considerable range in various meristic and morphometric features. For example, the gill rakers on the lower limb of the first gill arch range from 6 to 17, whereas Menon (1964) gave the range as 9-12 (Banister and Clarke 1975).

Trewavas (1941) pointed out that this species is closely related to Garra blanfordii, a species of eastern Ethiopia. Garra lamta resembles Garra tibanica in many features, but has larger eyes, the vent is more anteriorly placed and the caudal peduncle is shorter and deeper. Menon (1964) concluded that G. tibanica is most closely allied to G. quadrimaculata of Ethiopia but the latter differs in the more anterior position of the anus.

Banister and Clarke (1975) wrote: "Within the tibanica complex, there are two species from northeast Africa that have some significant similarities with Garra tibanica. In Garra makiensis (Boulenger) and Garra ethelwynnae (Menon) the anus is close to the anal fin and the body shape and the color pattern are the same as Garra tibanica. According to Menon (1964) Garra rufa resembles Garra tibanica even though they are

well separated geographically. G. tibanica and G. rufa are probably both derived from a primitive Garra which occupied the area from south China as far west as Africa via Afghanistan, Iran, Syria and Arabia (Menon 1964). Garra tibanica does not closely resemble other Arabian species. Garra longipinnis can easily be separated from G. tibanica by its thin body and very long paired fins, while G. barreimiae can be separated by its mottled pattern and the position of the vent (Banister and Clarke 1975).

Garra arabica, Hora is a dubious species. In the nineteenth century, W. T. Blanford sent fish specimens from the Wadi Tiban drainage at the southern tip of the Arabian Peninsula to the Indian Museum. Hora (1921) named a new species, Garra arabica, reputedly on the Arabian specimens. Trewavas (1941) mentioned that she examined a cotype specimen of G. arabica and found it closely resembled G. gotyla, an Indian species. Balleto and Spano (1977) examined 456 specimen from several localities of south Yemen. In an example of statistical overkill, they described 9 subspecies, all of the G. tibanica. None of their specimens resemble the description of G. arabica.

Only G. tibanica has been found in several coastal drainages of Arabia. It is possible that the specimens on which the name G. arabica is based did not come from Arabia, but due to a mix-up of specimens at the Indian Museum, "G. arabica" may actually be an Indian species. Future collections in the Wadi Tiban drainage would be necessary to shed more light on the validity of G. arabica.

Garra barreimiae Fowler and Steinitz, 1956

Garra barreimiae Fowler and Steinitz, 1956, Bull. Res. Coun. Israel
513(3-4):262-263.

G. barreimiae is known only from the drainages flowing from the Alakhdar Mountains to the Arabian Gulf and to the Gulf of Oman. Based on Banister and Clarke's (1975) description, large specimens possess a wedge-shaped snout. The snout bears distinctive patches of horny tubercles. The mental disc is wider than it is long and more constant in form than in G. tibanica. The anus is further from the anal fin in G. barreimiae than in G. tibanica. There are 4 unbranched and 6 to 8 branched dorsal rays. The anal fin has 3 unbranched and 5 branched rays. The lateral line has about 33 scales. Banister and Clarke agreed with Menon (1964) in aligning G. barreimiae with Garra pufa, a widely distributed species between the Mediterranean and the Tigris-Euphrates basin. They described a new subspecies, Garra barreimiae shawkahensis. G. b. barreimiae is restricted to drainages flowing to the Gulf of Oman and to the Oasis of Baraimi. G. b. shawkahensis is confined to the Wadi Shawkah which drains the northwest slopes of Alakhdar Mountains towards the Arabian Gulf.

Garra longipinnis Banister and Clark, 1975

G. longipinnis Banister and Clarke, 1975. Oman. Jour. Studies, Spec. Rep. (Sci. Results. Oman Flora and Fauna Survey): p. 137.

This species was described by Banister and Clarke (1975) from the village of Saig, Oman. Based on their description, the body is thin and the paired fins are long. The mental disc is well developed. There are 4 unbranched and 6 to 7 branched dorsal rays. There are 3 unbranched and 5 branched anal rays. The lateral line has 29 to 31 scales. There are 13-14 gill rakers on the lower limb of the first gill arch. Gill rakers are short and widely spaced. The authors suggested the close relationship between this species and Garra barreimiae based on the

development of the mental disc, the rounded shape of the snout in side view and a similar anus - anal fin distance (4.6% SL).

Unknown Garra

One specimen of a probable undescribed species of the genus Garra was collected from a spring at Alwastah, southwest of Almadinah. The body is deep, the snout is blunt. No tubercles on the sides and top of the snout. The specimen has two short pairs of barbels. The mental disc is wider than it is long (7 mm vs. 5 mm). There are small papillae on the anterior part of the mental disc. These papillae are not found on the posterior part. The caudal fin is forked, other fins are short. The pelvic fins do not reach the anus. The dorsal fin has two unbranched and six branched rays. The anal fin has two unbranched and five branched rays. There are 33 scales in the lateral line. Gill rakers are thin, short and widely spaced. On the anterior side of the first gill arch there are 13 gill rakers. On the posterior side of the first gill arch there are 18. The caudal peduncle is narrow and short. The proportional measurements of this specimen expressed in the thousandths of the standard length are: BD = 261; HL = 283, OL = 087; DO = 522; DFBL = 179; DFDF = 239; BL = 065; CPD = 108; CPL = 196; Snt·L = 109. The radii on the scales differ from G. tibanica scales. We prefer to examine more specimens before formally describing this new form of Garra.

Genus Mirogrex

Steinitz (1952) described a new species, Acanthobrama terraesanctae, from Lake Tiberias. This species was made the type of a new genus Mirogrex by Goren et al. (1973). The genus is characterized by a high number and the slender form of the gill rakers.

Our collections from the Wadi Hediah and Ain Aljymya, Khaybar contain 11 specimens representing the presence of this genus in Saudi Arabia. These collections are the first record beyond the limits of the Jordan River basin.

The mouth is almost superior. There are no barbels. The eyes are lateral and visible in ventral view. Lateral line is curved, and continues to the middle of the caudal peduncle. There are 50-56 scales in the lateral line. The dorsal fin has two unbranched rays and seven branched rays. The second unbranched ray is ossified, long and unserrated. The dorsal fin origin is behind pelvic fin origin. The anal fin usually concave and a sheath surrounds its base. It has 2 or 3 unbranched rays and 14 to 16 branched rays. Pectoral fin with 12-14 rays not extending to the origin of the pelvic. The pelvic fin usually has 9 rays. Gill rakers are relatively long and slender. Small papillae are present on most of the gill rakers. There are 16-17 gill rakers on the first gill arch. Proportional measurements of these specimens are presented in Table 5.

Although the characters of the Arabian specimens appear to be within the range given for Mirogrex terraesanctae, we are awaiting the opportunity to make a detailed comparison with specimens of M. terraesanctae before deciding on the taxonomic status of the Arabian specimens.

Table 5. Proportional measurements of Mirogrex specimens expressed in thousandths of the standard length.

Measurements	Hediah (N=6)		Ain Aljymya (N=5)	
	\bar{X}	Range	\bar{X}	Range
SL	65	44-75	35	31-48
BD	240	219-280	225	189-258
HL	249	243-253	306	271-344
OL	083	078-086	093	081-111
UJL	076	068-086	084	063-097
DO	506	469-534	507	479-519
DFBL	166	137-205	159	148-167
DFDL	295	274-313	316	297-333

Table 5. continued

Measure- ments	Hediah (N=6)		Ain aljymya (N=5)	
	\bar{X}	Range	\bar{X}	Range
AFBL	239	219-253	279	216-323
CPD	092	086-096	110	081-129
CPL	199	188-227	231	208-258
PFL	209	182-229	213 ¹	189-229
Snt.L.	065	053-078	089	063-111
IOW	080	067-091	123	104-148
LJL	074	067-082	---	-----
DSL (2nd unbranched) (N=5)	235	213-266	---	-----

¹N=3

FAMILY CYPRINODONTIDAE (TOOTH-CARPS)

This is a very large family commonly called "top minnows" or "tooth-carp." Typically small fish (<100 mm). Upper surface of the head is usually flattened. Mouth is terminal, specialized for feeding on surface. No barbels. No adipose fin. Swim bladder without duct. Fins spineless.

Aphanius dispar (Rüppell, 1828)

Lebias dispar Rüppell, 1828. Atlas zu der Reise in Nordlichen Afrika, 4. Fische des Rothen Meers:66.

D I-7 or II-7, A I-8 or II-7, L. L. 26-28, P. 13-14

A total of 93 specimens were examined. They ranged from 30 to 60 mm SL. This species appears to be the most widely distributed species in Arabia (Figure 2). This distribution is due to the salinity tolerance of cyprinodont fishes which allow movement through the sea. Members of this species are sexually dimorphic. Specimens rarely reach 80 mm. In

the adult male, the dorsal fin is twice as high as that of the adult female. Aphanius dispar exhibits considerable variation in the specimens examined. They have 13-16 gill rakers on the anterior side of the first arch and 15-23 gill rakers on the posterior side of the first arch. There are 26-28 scales in the lateral line. The dorsal fin has two unbranched rays and eight branched rays. The anal fin has eight rays. In the male, the dorsal profile is arched. Pectoral fin overlaps pelvic fin, pelvic overlaps anal fin. Fins are long and pointed. Dark blue speckles occur on the dorsal and anal fins of the male. Males are brightly colored, brown to dark blue, with numerous irridescent, blue-silver blotches in rows on the flanks and weak brownish transverse bars above the caudal peduncle. Dorsal and anal fins with silvery blotches and dark spots. Pectoral and pelvic fins are yellow. Females are gray with a bluish-silver sheen. Numerous transverse bars on the flank. Fins are small and rounded in female. In all specimens, teeth are tricuspid. Peritonium black. The stomach is well developed. The presence of this species in the eastern regions and Al-Kharj has not been mentioned before.

FAMILY: POECILIIDAE

Viviparous, more than 25 genera in North and South America. Anal fin of the male produced, its 3rd, 4th and 5th rays modified into a copulatory organ.

Gambusia affinis (Baird and Girard)

D 6 (last two rays taken as one), A 8-9, L.L. 28-30.

Two specimens SL 34 and 36 mm were collected from a spring in Al-Kharj City (Figure 2). G. affinis is a small fish, seldom exceeding

60 mm. The gill rakers number 12-14. The dorsal fin has six rays. The lateral line scales range from 28 to 30. The genus Gambusia has been introduced throughout the world to control malaria. This is the first record of the species in Saudi Arabia. There should be a general awareness in Saudi Arabia concerning the potential danger that introductions of exotic species have for native species and for disruptions of ecosystems. Thus, it is important to complete a comprehensive survey of Arabian fishes to document the occurrence and status of all native species in order to better protect them from habitat destruction and non-native fish introduction. The native "top minnow," Aphanius dispar, can probably act as an effective biological control for mosquitoes. Saadati (1977) pointed out that G. affinis had replaced Aphanius from much of the range in Iran. Al-Daham et al. (1977) discussed interaction between Gambusia and three species of Aphanius in southern Iraq. In the future, we urge that native species should be used for introductions.

DISCUSSION

About 600 specimens were collected in 1977 and 1981 from 29 localities of eastern, northwestern and southwestern Saudi Arabia. The most common and ubiquitous species, Aphanius dispar, made up most of the total numbers of specimens.

Our collections made in 1977 and 1981, although restricted to Saudi Arabia, represent the most extensive sampling of freshwater fishes yet made from the Arabian Peninsula. Besides the species described by Banister and Clarke, a new species of the genus Cyprinion (C. mhalensis), a new species of the genus Barbus (B. nemus), the first record of the genus

Mirogrex, and an undescribed species of the genus Garra are recorded.

Although no fish collections have yet been made in vast regions of Arabia and much is yet to be learned, some general conclusions can be made. It appears that the original African fish fauna existing up to the time of the initiation of the Red Sea rift in the Miocene were completely eliminated. Virtually all species of primary freshwater fishes now known in Arabia are endemic species. This fact indicates long isolations.

The genus Cyprinion is of Asiatic origin and is represented by one non-endemic and two endemic species. All Arabian Cyprinion are part of the "C. watsoni species complex." It is not known if C. acinaces and C. mhalensis are the result of divergence from a common ancestor in Arabia or from separate invasions of separate ancestral progenitors across the Arabian Gulf from Iran during periods of low ocean levels and a Gulf freshwater environment. The Cyprinion "watsoni" native to Oman appears to represent the most recent and least differentiated invader from Iran.

The genus Garra, also of Asiatic origin, crossed the Arabian Peninsula to become established in northeast Africa. Garra is represented by four, possibly five (depending on validity of G. arabica), endemic species. There is a question concerning Garra tibanica as an endemic Arabian species. Menon (1964) recorded G. tibanica from Somalia. There is such variability and diversity in Menon's "Tibanica complex" that we consider the identification of Somalian specimens as G. tibanica, at best, doubtful in considering the time of isolation.

The four endemic species of Arabian Barbus suggest two ancestral origins. B. apoensis and B. nemus may be derived from an ancestor associated

with the B. canis-B. luteus group invading from the north (Jordan R.) or from the east (Tigres-Euphrates or Mond R.)

B. arabicus and B. exulatus may be derived from an ancestral member of the Barbus intermedius complex, invading across the southern end of the Red Sea during a period of freshwater connections from northeast Africa. The Mirogrex species seems clearly to have invaded the western Arabian Peninsula from the Jordan River basin.

Aphanius dispar, because of its ability to disperse through seawaters, does not represent ancient relict populations divergent from the parent species. The present distribution of Aphanius is assumed to be of late Pleistocene origin, when presently isolated internal basins had direct outlets to surrounding seas.

In Arabia, no fish collections have yet been made from the Ar-Rumah (= Al-Batin), Euphrates and As Sirhan basins. The other basins have not been extensively collected. Much is yet to be learned on the freshwater fishes of Arabia.

Ichthyological studies can be of critical significance for interpretation of the climatic and hydrographic history of the country. Also, freshwater fish can become a more important part of the Arabian economy by increasing the supply of protein, by providing recreational and esthetic values and perhaps as a biological control agent for vegetation problems and disease vectors. However, introductions of non-native species without suitable planning and evaluation of all possible ramifications can cause ecological catastrophies.

Utilization of native fishes to serve national interests should be given priority. A continuation of the present study is necessary to complete the documentation of species, their distribution and habitats

before extinction caused by water development projects occurs. Our study on the freshwater fish fauna of Saudi Arabia emphasizes the need for a national awareness to preserve all native plants and animals and develop an environmental conscience to protect the national's biological heritage.

The prophet Muhammad urges the nations to be merciful and helpful to all of God's creatures. Thus, the development of an environmental conscience has a basis in the religious and cultural heritage of Islam. Abu Huraira tells us that Allah's Apostle said: "While a man was walking on a road, he became very thirsty. Then he came across a well, got down into it, drank of its water and then came out. Meanwhile, he saw a dog panting and licking mud because of excessive thirst. The man said to himself, "This dog is suffering from the same state of thirst as I did.". So he went down the well (again) and filled his shoe (with water) and held it in his mouth and watered the dog."

Allah thanked him for that deed and forgave him. The people asked, "O, Allah's Apostle! Is there a reward for us in serving animals?" He said, "Yes, there is a reward for serving any living being."

The original Arabic text is as follows:

*Sahih Al-Bukhari, 2nd edition, 1977, Vol. VIII, Hilah Yayinlari, P.O. Box 448, Ankara, Turkey.

ACKNOWLEDGEMENTS

We thank colleagues of the Zoology Department, College of Science, Riyadh University, Saudi Arabia, who supported this study. We thank Dr. Naser Alassgah of the Zoology Department, Riyadh University, for providing us with some of his collections. The drawings of the map and the species are the work of Mrs. Doris M. Rust, Colorado State University. Communications with Dr. Keith Banister, British Museum, and Dr. Brian Coad, National Museum of Canada, have been helpful and their further contributions should provide for more definitive taxonomic conclusions in subsequent publications.

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Figure 1. Major drainage basins of Arabian Peninsula.

Figure 2A. Distribution of freshwater fishes Barbus apoensis (■), B. exulatus (▲), B. arabicus (□), B. nemus (✱), Aphanius dispar (▲), Gambusia affinis (✱), Mirogrex sp. (☆).

Figure 2B. Distribution of freshwater fishes: Cyprinion watsoni (✱), C. acinaces (■), C. mhalensis (✱), Garra tibatica (☆), G. barreimiae barreimiae (▲), G. b. shawkahensis (▲), G. longininnis (□), Garra sp. (✱).

Figure 3. Barbus apoensis, 176 mm SL (adapted from Banister and Clark 1975).

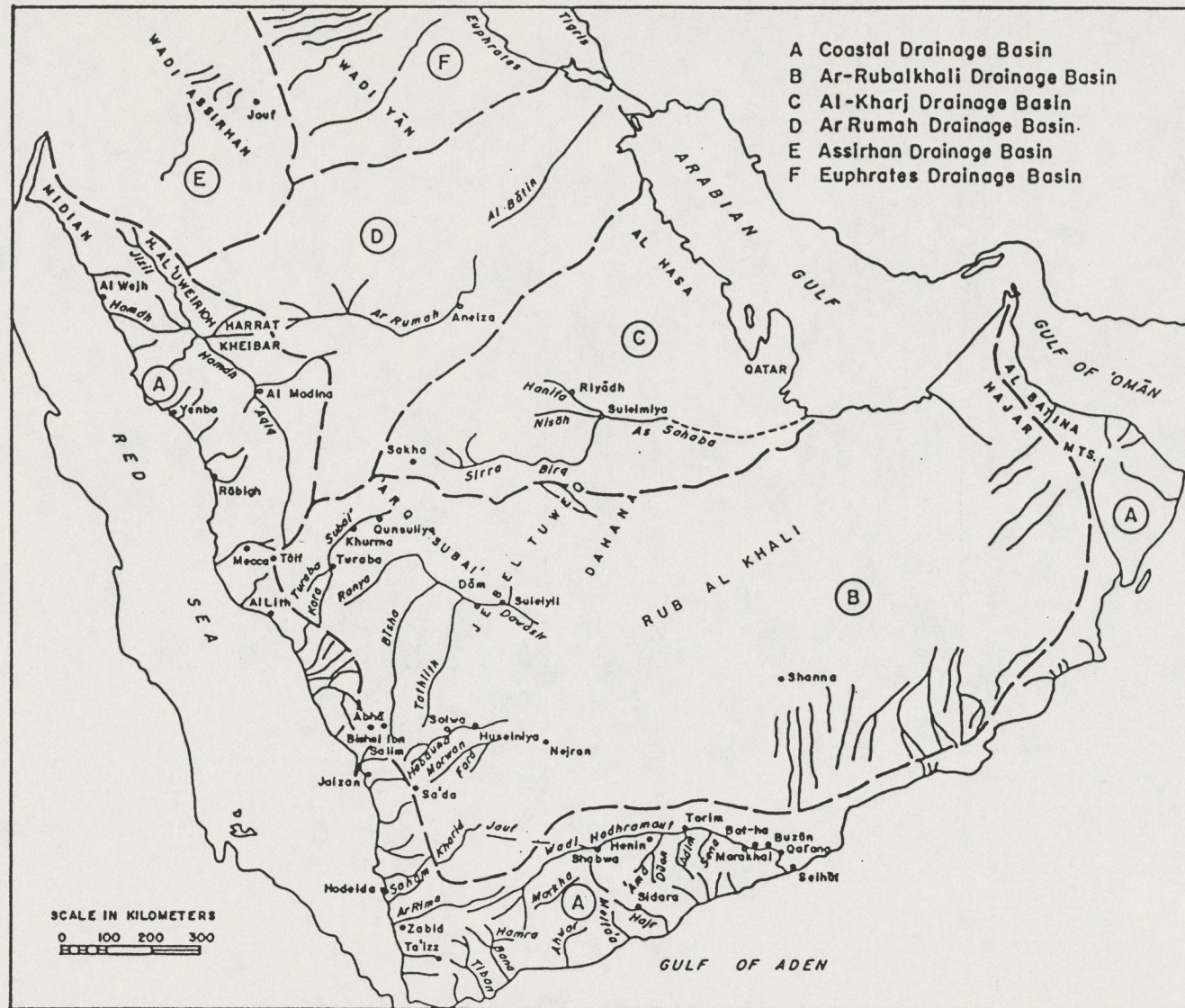
Figure 4. Barbus nemus, 81 mm SL.

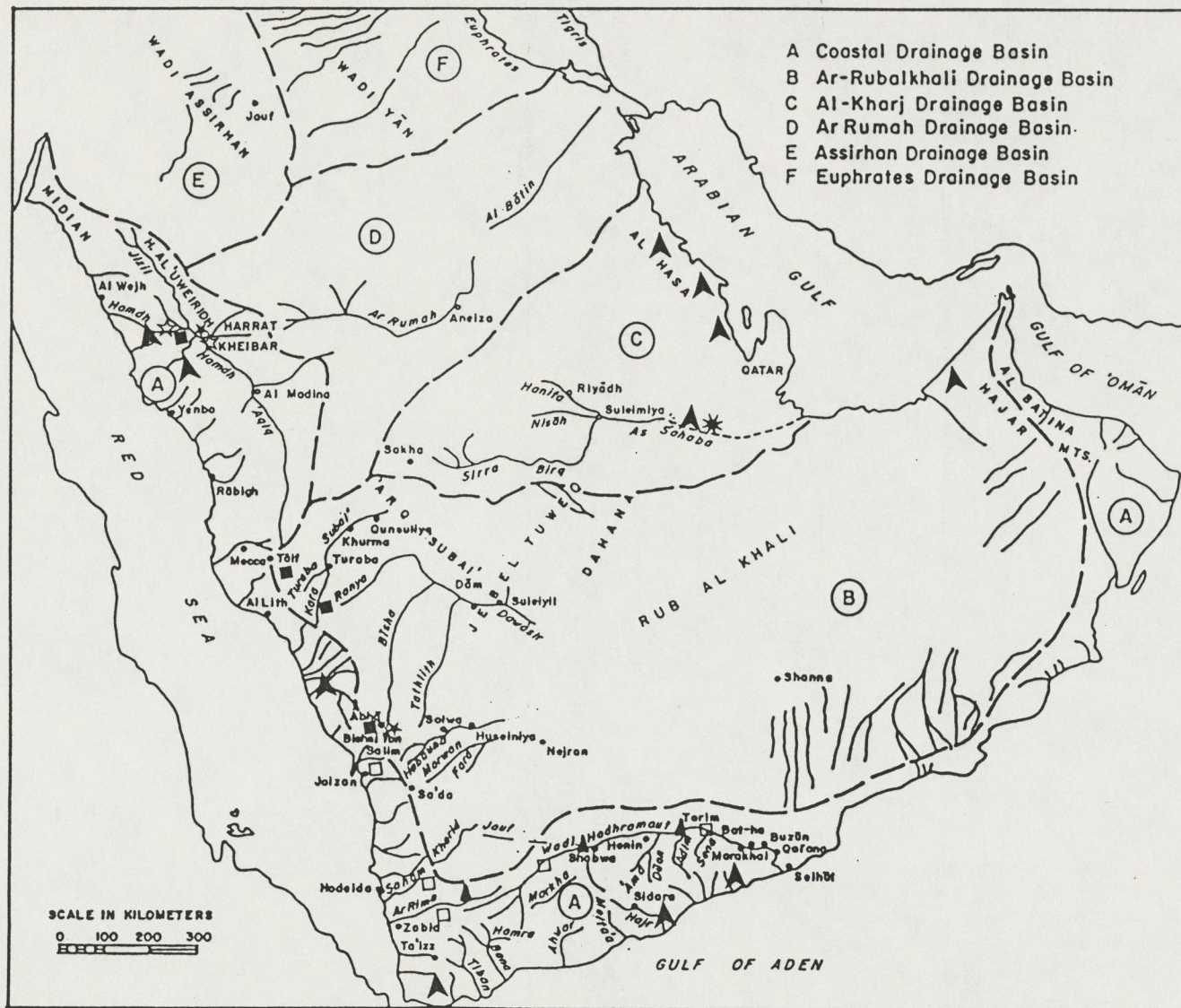
Figure 5. Cyprinion acinaces, 110 mm SL.

Figure 6. Cyprinion mhalensis, 141 mm SL (A). Cyprinion of uncertain identity, 124 mm SL (B).

Figure 7. Garra tibanica, 78 mm SL.

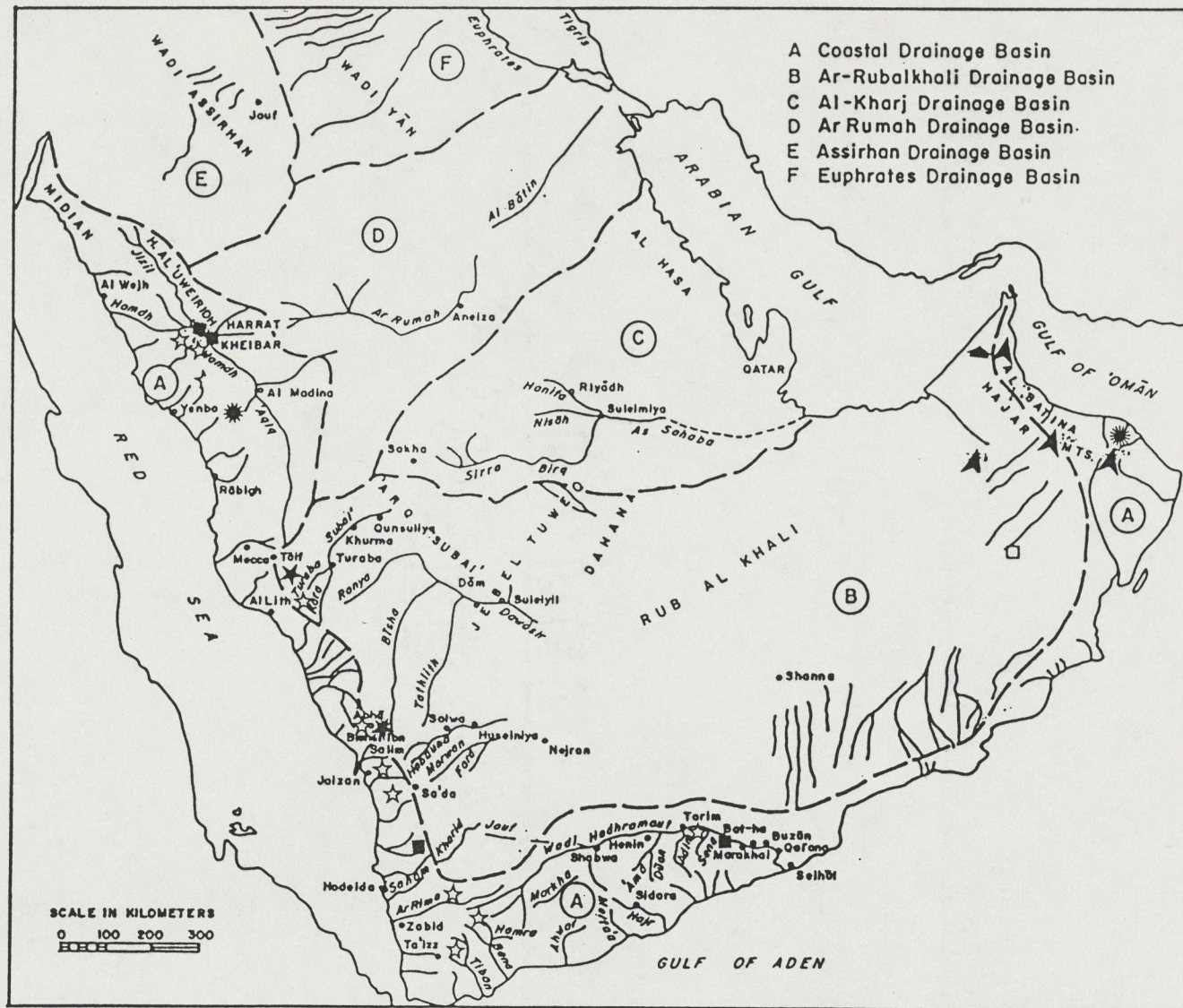
Figure 8. Mirogrex sp. 75 mm SL.



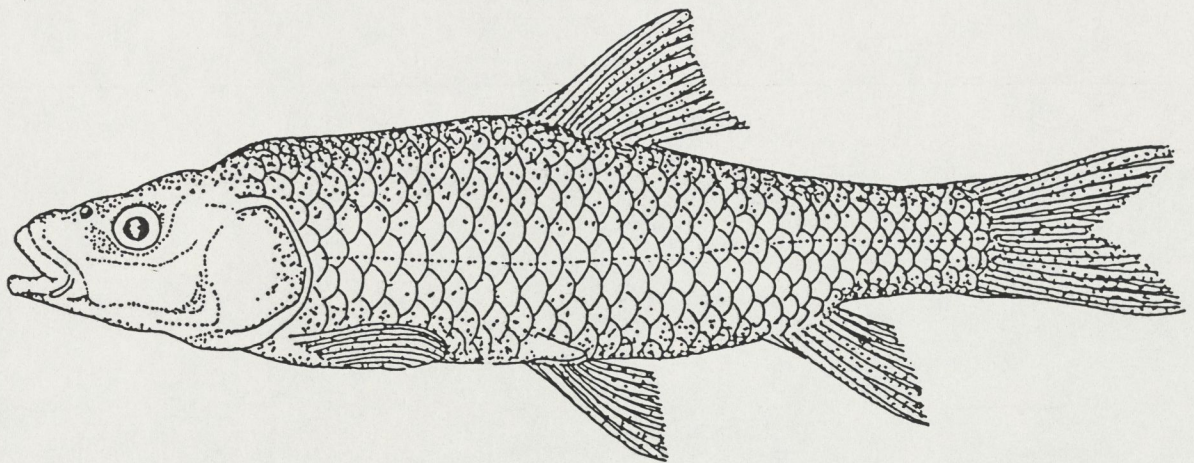


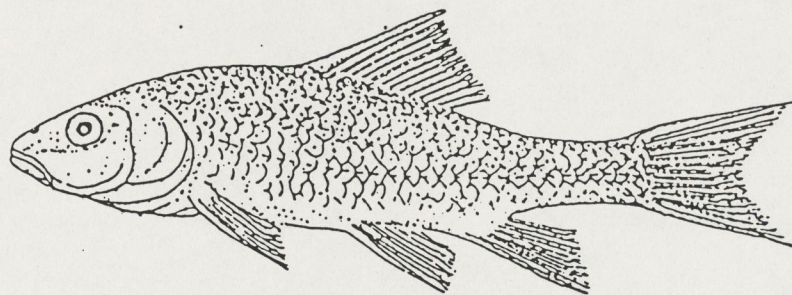
- A Coastal Drainage Basin
- B Ar-Rubalkhali Drainage Basin
- C Al-Kharj Drainage Basin
- D Ar Rumah Drainage Basin
- E Assirhan Drainage Basin
- F Euphrates Drainage Basin

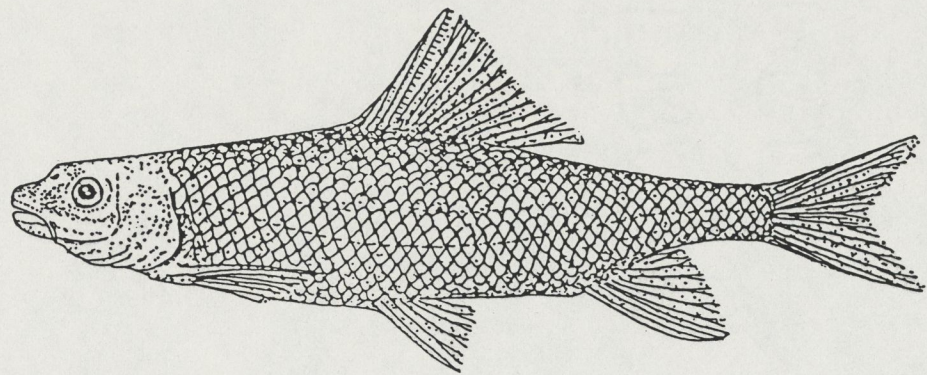
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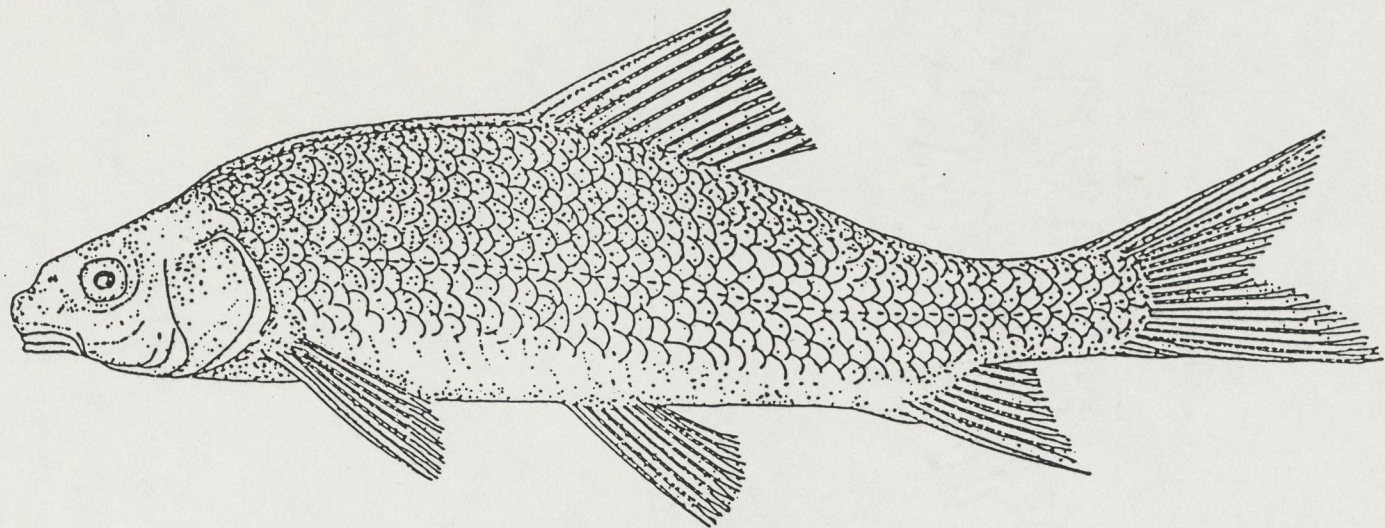
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أَنَّ رَسُولَ اللَّهِ صَلَّى اللَّهُ عَلَيْهِ وَسَلَّمَ قَالَ :
بَيْنَمَا رَجُلٌ يَمْشِي بِطَرِيقٍ اشْتَدَّ
عَلَيْهِ الْعَطَشُ ، فَوَجَدَ بِشْرًا فَنَزَلَ فِيهَا
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بِأَكْلِ التَّرْتِى مِنْ الْعَطَشِ ، فَقَالَ الرَّجُلُ :
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فَمَلَأَ خُفَّهُ ، ثُمَّ أَمْسَكَهُ فِي يَدِهِ فَسَقَى
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قَالُوا : يَا رَسُولَ اللَّهِ ، وَإِنْ لَنَا فِي الْبَهَائِمِ
أَجْرٌ ؟ فَقَالَ : فِي كُلِّ ذَاتِ كَبِدٍ رَطْبَةٌ
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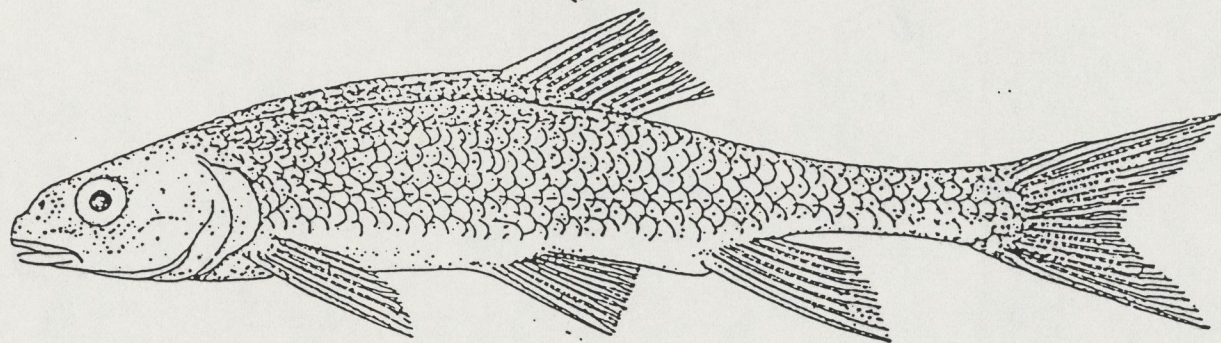


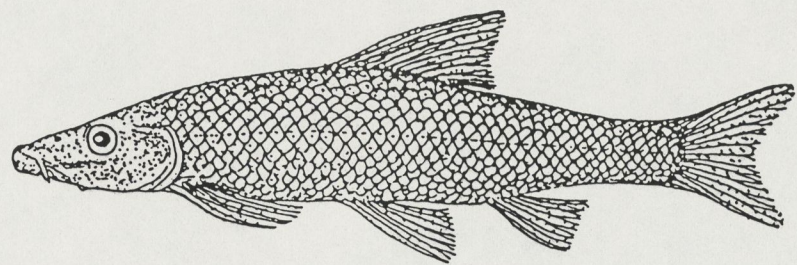


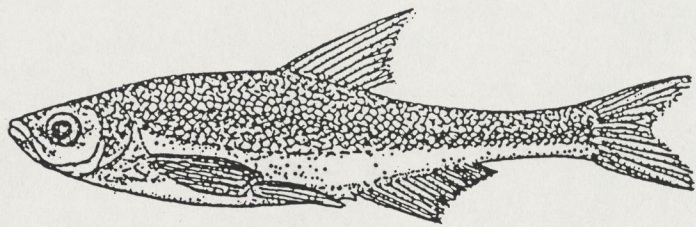
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OFFICE MEMO
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To Bob Behrke

Date 10-27-83

From Maion Hershoff

Action:

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For:

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FRESHWATER FISHES OF SAUDI ARABIA

by H. F. Alkahem and R. J. Behnke
Department of Fishery and Wildlife Biology
Colorado State University
Fort Collins, Colorado 80524
U.S.A.

Abstract: This work reports on the first comprehensive scientific collection of freshwater fishes from Saudi Arabia. The collections include the first record of Garra from the Arabian Peninsula. A new species of Garra is described. Unusual specimens of Garra, Leuciscus and Leuciscus indicate the occurrence of other undescribed species.

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A comprehensive appraisal of geological, geographical and climatic events correlated with zoogeographical evidence and an interpretation of the degree of divergence in living species can provide an interpretation of factors explaining the present distribution and taxonomy of freshwater fishes.

Cultural and religious bases are presented as a rationale for preserving and protecting the native fishes of Arabia as a part of the biological heritage of the land.

FRESHWATER FISHES OF SAUDI ARABIA

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Department of Fishery and Wildlife Biology
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Abstract: This work reports on the first comprehensive scientific collection of freshwater fishes from Saudi Arabia. The collections include the first record of the genus Acanthobrama from the Arabian Peninsula. A new species, Cyprinion mhalensis is described. Unusual specimens of Garra, Barbus, and Cyprinion indicate the occurrence of other undescribed species.

A comprehensive appraisal of geological, geographical and climatic events correlated with zoogeographical evidence and an interpretation of the degree of divergence in living species can provide an interpretation of factors explaining the present distribution and taxonomy of freshwater fishes.

Cultural and religious bases are presented as a rationale for preserving and protecting the native fishes of Arabia as a part of the biological heritage of the land.

INTRODUCTION

The Arabian Peninsula consists of several nations. The largest is the Kingdom of Saudi Arabia, which occupies some four-fifths of the Arabian Peninsula (= Arabia).

During the Mesozoic and most of the tertiary, Arabia was part of a continuous African-Asiatic land mass. The Red Sea rift developed as a terrestrial trough in the Oligocene (Roberts 1975). The Mediterranean Sea invaded this trough in the Miocene and was continuous with the Indian Ocean in the late Miocene or Pliocene. Thus, Arabia became isolated from Africa for a time (Roberts *op.cit.*). Late in the Pliocene, uplift probably created a temporary land connection across the strait of Bab al Mandab (Roberts *op.cit.*). The Arabian Gulf is a shallow tectonic depression formed late in the Tertiary in the front of the rising Zagros Mountain (Kassler 1973). The sea level fell by as much as 120 m during the Pleistocene. During the period(s) of low sea level the Gulf became a freshwater lake from the outflow of the Tigris and Euphrates rivers (Kassler *op.cit.*).

Freshwater fishes are the best evidence of past land connections with Arabia serving as a bridge between northeast Africa and Asia, because primary freshwater fishes (mainly of order Cypriniformes) are restricted to freshwater and can only disperse by freshwater routes.

Little is known of Arabian freshwater fishes. Berg's (1934) map of fish zoogeography has a question mark (?) on the Arabian Peninsula. The literature of freshwater fishes of Arabia is very sparse. Boulenger (1887) described a new species of cyprinid fish from Muscat on the east coast of Arabia. Trewavas (1941) described three new

species of cyprinids based on collections from southwest Arabia. Fowler and Steinitz (1956) described a new cyprinid species from Oman. Balletto and Spano (1977) described nine subspecies of Garra tibanica from the Republic of Yemen. The most comprehensive work on freshwater fishes of the Arabian Peninsula, with the first mention of freshwater fish from Saudi Arabia is the study of Banister and Clarke (1977). They recognized nine species of three genera of the family Cyprinidae and one species of the "top minnow" family Cyprinodontidae. All except one of the cyprinid species are considered endemic to Arabia, indicating the long isolation of most of Arabia from direct freshwater access routes of invasion.

Our collections made in 1977 and 1981, although restricted to Saudi Arabia, represent the most extensive sampling of freshwater fishes yet made on the Arabian Peninsula. We found all of the species described by Banister and Clarke from Saudi Arabia plus a new species of Cyprinion and indications of undescribed species of Barbus and Garra, and the first record of the genus Acanthobrama from Arabia. The American mosquito fish, Gambusia affinis (Poeciliidae), is the first Arabian record of a non-native freshwater fish.

It is important that further studies be initiated soon to increase the knowledge of the freshwater fish fauna before industrial and agricultural development occur on a large scale and inalterably change or destroy the fragile freshwater habitats. Groundwater pumping has already dried springs in some areas. Water development projects will dramatically alter much of the present aquatic habitats

and exotic fish species will likely be introduced. Unless the present fish fauna is studied and documented, species may become extinct before they were known to exist.

Figure 1 illustrates six separate drainage basins based on the topography of the Peninsula. It is assumed that during major pluvial periods, all drainage within any one of the present internal basins would have been interconnected, allowing the opportunity for dispersal of fishes throughout a basin.

METHODS AND MATERIALS

Fishes were collected by means of seines and hook and line. Fish specimens were immediately preserved in 10% formalin solution and later transferred to 40% isopropyl alcohol. Samples were collected in 1977 and 1981 from the Wadi Almhaleh, a permanent stream southeast of Abha City, from waters near AlHufuf, Nejran, Jaizan, Alkharj, Khaybar, and from the Wadi Hediah (west of Khaybar City). Other drainages such as Tabuk, Alula, Aljawf and Alaflaj were visited, but no evidence of fish was found.

A total of 208 specimens were examined. Measurements and counts on specimens were made according to the standard methods of Hubbs and Lagler (1958) with some particular modifications in accordance with Banister and Clarke (1977). Specimens are presently maintained in fish collections in the Department of Fishery and Wildlife Biology, Colorado State University, Fort Collins, Colorado, USA. Some specimens have been deposited in the National Museum of Natural Sciences, National Museums of Canada.

The following abbreviations for counts and measurements are used in the manuscript:

TL	Total Length
SL	Standard Length
BD	Body Depth
HL	Head Length
OL	Orbit Length
UJL	Upper Jaw Length, measured from barbel to snout-tip
DO	Dorsal Origin to snout-tip
DFBL	Dorsal Fin Basal Length
DFDL	Dorsal Fin Depressed Length
CPD	Caudal Peduncle least Depth
CPL	Caudal Penduncle Length
IL	Intestine Length
AFDL	Anal Fin Depressed Length
BL	Barbel Length (Posterior barbel)

D	Number of Dorsal Fin Rays (Roman numeral for unbranched rays, Arabic numeral for branched rays)
A	Anal Fin Rays
P	Pectoral Fin Rays
V	Ventral or Pelvic Fin Rays
L. L.	Scale count in Lateral Line
PFL	Pectoral Fin Length
AFBL	Anal Fin Basal Length
Snt.L.	Snout Length
IOW	Interorbital Width
DSL	Dorsal Spine Length (= longest unbranched spine)
HD	The horizontal distance from the tip of the snout to the pelvic fin origin
NMC	National Museum of Canada

PREVIOUS STUDIES OF FRESHWATER FISHES OF ARABIA

The first description in the literature of freshwater fish from Arabia was by Boulenger (1887) who described a new species, Scaphiodon muscatensis, from Muscat. Berg (1949) synonymized Scaphiodon muscatensis with Cyprinion microphthalmum, a widespread species in Iran and Pakistan. Hora (1921) described a new species, Garra arabica, from Lahej, near Aden, South Yemen. Trewavas (1941) described three new species: Barbus arabicus, Garra tibanica, and Garra brittoni and recorded the occurrence of Aphanius dispar (Cyprinodontidae) from Yemen, based on collections made by the British Museum of Natural History Expedition to Southwest Arabia, 1937-38. Fowler and Steinitz (1956) described a new species, Garra barreimiae, from Oman. Balletto and Spano (1977) studied Garra tibanica from Yemen and described nine subspecies.

The most comprehensive publication on the Arabian freshwater fishes is by Banister and Clarke (1977) in which collections from Saudi Arabia are mentioned for the first time. They list nine

species: eight cyprinids and one cyprinodont: four of the cyprinids are described for the first time--Barbus apoensis, Barbus exulatus, Cyprinion acinaces and Garra longipinnis.

Van Couvering (1977) mentioned fossil cichlids (family Cichlidae) and Barbus-like material of unknown age from Ad Darb, Red Sea coast. Brown (1970) mentioned a Miocene fossil of Barbus in the Jaizan basin near Tihama north of the Yemen boundary.

Figures 2A,B illustrate the known distribution of Arabian freshwater fishes based on previous literature and the results of our study.

FAMILY CYPRINIDAE

Cyprinids lack an adipose fin, and jaw teeth are also absent (Berra 1981). Body usually scaled. About 275 genera in the freshwaters of the world except South America, Australia and Madagascar (Nelson 1976).

Genus Barbus Cuvier, 1817

Barbus Cuvier, 1817, Regne, anim. II, p. 192 (type: B. barbus).

Typically with two pairs of barbels, seldom one or none. Mouth inferior, lips well developed. Pharyngeal teeth are 2.3.5-5.3.2 or 2.3.4-4.3.2. Peritoneum white or dark brown or black. Anal fin with 5 or 6 branched rays.

Taxonomic Outline

A most difficult and confusing problem of ichthyology is the classification of the African, Asiatic and European fish of the genus Barbus (Myers 1960). Barbus contain many phyletic lines of greater or lesser extent and the aggregate transcends the limit of what the majority of ichthyologists would consider a single genus (Myers op.cit.). Günther suggested it is necessary to subdivide several sections of the genus purely on geographical ground before he would handle the classification expeditiously (Myers op. cit.). Boulenger divided Barbus into several sections, based on scale characters and it seems possible that these sections are of phylogenetic importance (Myers op. cit.).

Northeast African Barbus (large scale) and a group of large-scaled Near Eastern Barbus are the logical ancestor types of Arabian Barbus species.

Distribution

Barbus is widespread in temperate or tropical parts of Europe, Asia, and Africa. The range of the genus in Arabia is the coastal drainages of the Red and Arabian seas and a new record from our collections is the occurrence of B. apoensis in the Wadi Almhaleh draining to the Ar Rub'al Khali internal basin.

Several Barbus species occur in the Tigres-Euphrates basin, and B. barbulus and B. luteus are known from the Mond River drainage of Iran. No other Arabian Gulf drainages were found to have Barbus (Saadati 1977). The number of Barbus species in Arabia is yet to be determined. Three species are currently recognized. Barbus apoensis is known from the Wadi Almhaleh southeast of Abha, the Wadi Turaba

near Ataif and the Wadi Adamah, 19° 53' N, 41° 57' E. Barbus exulatus is known from several localities in the Wadi Hadhramaut and Wadi Maran in East Yemen. Barbus arabicus is widespread in the southwestern part of Arabia. Distinctive specimens from the Wadi Almhaleh, southeast of Abha City and Khaybar drainages, indicate an undescribed species (Figure 2).

Barbus apoensis Banister and Clarke, 1977

Barbus apoensis Banister, K. and M. A. Clarke. 1977. Jour. Oman Studies, Spec. Rep. (Sci. Results, Oman Flora and Fauna Survey): p. 113.

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Specimens Examined

One specimen, 274 mm SL, caught July, 1977, from Wadi Almhaleh (17° 58' N, 43° 24' E), a permanent stream southeast of Abha City. Eight specimens, 90-205 mm SL, were collected June, 1981, from Wadi Hediah, west of Khaybar City. Three specimens, 60-62 mm SL, were caught July, 1981, from Ain (= spring) Aljymma, Khaybar. Khaybar City is at 25° 42' N, 39° 31' E.

Description

The shape of the body can be seen in Figure 3. This species was described by Banister and Clarke (1977) from a permanent stream near Khamis Mushayt and other localities in Saudi Arabia. They based their description on 12 specimens. According to their description:

"The greatest depth of the body occurs about halfway between the origin of the pectoral fin and the origin of the dorsal fin. A pronounced nuchal hump is present and the dorsal profile of the head is concave. The mouth is terminal and has marked upwardly directed gape. The posterior barbels are small. The eyes are lateral and slightly protuberant. The lips are continuous. There are 4 unbranched rays in the dorsal fin. The last one is thickened into an unserrated, smooth spine. The spine is not strongly ossified and is flexible in its distal third. There are 10 branched dorsal rays. The lateral line scales number 26-29. Twelve scales encircle the least circumference of the caudal peduncle. There are 2.3.5-5.3.2 pharyngeal teeth. The gill rakers are strong, curved and widely spaced. They decrease rapidly in size from the angle of the gill arch forwards. On the lower limb of the first gill arch there are 6-9 gill rakers."

The specimens examined show the characters described above except for some differences noted, such as 24-31 scales in the lateral line instead of 26-29 and 10-13 scales around the least circumference of the caudal peduncle. The lateral line is straight. Proportional measurements of Barbus apoensis expressed in thousandths of the standard length are presented in Table 1.

Coloration

Living specimens have a brassy-golden coloration with olive fins. Preserved specimens are pale-yellow below and gray-brown above.

Distribution

This species is known from Wadi Almhaleh, south east of Abha, Ain Aljmyma, Wadis Turaba, Adamah, and Hediah, Saudi Arabia (Figure 2).

Relationships

A group of three related Near Eastern Species of Barbus, B. canis, B. chantrei, and B. luteus, suggests a common progenitor for them as well as for B. apoensis. The three Near Eastern species and

B. apoensis share a set of characters differentiating them from other Near Eastern Barbus--6 branched anal rays (vs.5), few gillrakers, typically 10 branched dorsal rays (vs. typically 8) and low lateral line scale counts (23 to 38 vs. 40 or more). B. canis and B. chantrei have two pairs of barbels. B. luteus and B. apoensis have a single pair of barbels. All four species have an unserrated dorsal spine. B. exulatus and B. arabicus have two pairs of barbels and an unserrated dorsal spine. B. exulatus typically has 9 branched dorsal rays and B. arabicus 8. B. canis is endemic to the Jordan River basin, B. chantrei to the Orontes basin, and B. luteus is more widely distributed in the Tigres-Euphrates and Mond river basins.

Table 1. Proportional Measurements of Barbus apoensis Expressed in Thousandths of the Standard Length.

Measurements	Wadi Hediah (n=8)		Ain Aljyma (n=8)		Wadi Almhaleh (n=1)
	\bar{X}	Range	\bar{X}	Range	
SL	144	90-205	61	60-62	273
BD	271	254-279	290	279-300	307
HL	322	296-351	372	367-377	321
OL	065	050-089	087	081-098	051
UJL	106	097-117	098	097-100	095
DO	535	514-556	563	516-590	544
DFBL	177	157-194	180	161-200	153
DFDL	259	227-284	328	306-350	237
BL	059	043-078	066	064-067	036
CPD	104	086-112	120	113-131	109
CPL	138	108-163	153	143-164	164
HD	528	498-561	579	574-583	---
IOW	110	102-114	120	113-133	---
PFL	209	196-224	230	210-250	---
DSL	210	173-255	213	210-217	---

Barbus exulatus Banister and Clarke, 1977

B. exulatus Banister, K. and M. A. Clarke. 1977. Jour. Oman Studies, Spec. Rep. (Sci. Results, Oman Flora and Fauna Survey): p.116.

The description of this species was based on several localities associated with the Wadi Hadhramaut and Wadi Maran, East Yemen. According to the description, the body is slightly compressed and the dorsal profile is arched. Two pairs of barbels are present. There are 4 unbranched and 7-9 branched dorsal rays. There are 3 unbranched and 6 branched anal rays. The lateral line scale count ranges from 24-28. Gill rakers are short and widely spaced. Their count on the lower limb of the first gill arch ranges from 6-9.

Barbus arabicus Trewavas, 1941

Barbus arabicus Trewavas, 1941, British Museum (Natural History) expedition to South-West Arabia 1937-8, 1(3):14.

One fish, 250 mm SL, from Wadi Jaizan Dam, near Jaizan City, collected by Dr. Naser Alassgah, March, 1981, was examined.

Description

The type locality of this species is unknown. The holotype was purchased at a market at San'a, North Yemen. In addition, Banister and Clarke (1977) recorded it from several localities of south and southwestern Arabia (Figure 2). According to their description:

"The body is slim and graceful. The snout obtusely pointed in lateral view. The mouth is subterminal. There are two long pairs of barbels. The eyes are small and superolateral in positions. The dorsal fin has 4 unbranched rays (the last of which is ossified into a smooth straight spine) and 7-9 branched rays. The anal fin has three unbranched rays and five branched rays. There are 25 to 32 scales in the lateral line. There are 12 scales around the least circumference of the caudal peduncle. The gill rakers number 9-13 on the lower limb of the first gill arch."

The specimen examined from Wadi Jaizan Dam shows the characters described above. Small protuberances on some gill rakers of the first gill arch were noted. The later character has not been mentioned before. The proportional measurements of the examined fish expressed in thousandths of the standard length are:

BD = 288, HL = 256, OL = 036, UJL = 068, DO = 480, DFBL = 136, DFDL = 152, BL = 088, CPD = 136, and CPL = 172.

Distribution

This species seems to be widespread in southwestern and southern coastal drainages (Figure 2).

Relationships

Barbus arabicus can be distinguished from all other Arabian Barbus on the basis of five branched rays in the anal fin. Trewavas (1941) considered this species to be more closely related to some Indian species and to Barbus canis than to any of the African Barbus. However, Barbus canis has 6 branched rays in the anal fin, an important difference between B. arabicus and B. canis. Banister and Clarke (1977) and Banister (1973), aligned Barbus arabicus with the species of Barbus of northeastern Africa--the Barbus intermedius

complex for the following reasons: The morphological similarity between the species, i.e. the possession of the same type of scale striation (more or less parallel), a caudal peduncle longer than deep, and a well ossified straight dorsal spine. The phenotypic variability of Barbus arabicus parallels Barbus intermedius (Banister 1973). The distribution of Barbus arabicus, i.e. in the southern part of Arabia just across the Red Sea from Barbus intermedius, suggests an African origin (Banister and Clarke 1977).

Perhaps the B. intermedius complex of northeast Africa represents an earlier branch of the phyletic line giving rise to the three near Eastern Barbus species discussed previously (lower numbers of dorsal and anal rays are probably primitive characters). B. arabicus typically has 8 branched dorsal rays and the typical number of these rays in B. exulatus is 9. B. arabicus and B. exulatus both have two pairs of barbels.

Unknown Barbus

During the study of Barbus specimens, seven specimens were segregated from typical B. apoensis specimens on the basis of a distinctive phenotypic appearance. These specimens include two from the Wadi Almhaleh (78,81 mm SL), two from Ain Aljyma, Khaybar (35,41 mm SL), and three the Wadi Hediah, west of Khaybar (41-61 mm SL). All of these collections contained typical B. apoensis.

The distinctive specimens were separated from B. apoensis specimens on the basis of head and mouth morphology, and coloration. A detailed comparison between these specimens and B. spoensis revealed

similarities in most morphological and meristic characters. The number of specimens available for study does not allow for definitive conclusions on the status of the distinctive specimens but nonoverlapping values were found between these specimens and B. apoensis of comparable size in interorbital width (less in apoensis), width of gape (less in apoensis), head length (greater in apoensis), and depth of the caudal peduncle (deeper in apoensis).

The pectoral fins in the distinctive specimens reaches the origin of the pelvic fins; the pectoral fins do not reach the pelvic fins in our typical apoensis specimens. In comparison, typical apoensis specimens have darker pigmentation, the body rises more abruptly in back of the head, and the scales are more stout in structure and more deeply embedded.

Many alternative explanations could be developed to consider the distinctive specimens only as variation within Barbus apoensis or as due to environmental influences during early life history. Detailed study of additional specimens from these sites will be necessary before sound conclusions can be made on the status of the "atypical" Barbus specimens. Figure 4 illustrates the unknown Barbus.

Genus Cyprinion Heckel

Cyprinion Heckel, 1843, Russeger's, Reisen, 1, p. 1015, 1065 (type: C. macrostomus).

Fishes of moderate size; scales of moderate size; dorsal fin with an osseous and serrated spine and numerous branched rays; mouth subterminal; pharyngeal teeth 2.3.4-4.3.2; one pair of barbels;

peritoneum black; alimentary canal long and convoluted; air bladder bipartite; seven branched anal rays. A revised diagnosis of the genus was given by Howes (1982).

Distribution

This genus is widespread in west Pakistan, Afghanistan, Arabia, Iran, Iraq and Syria. It occurs in all drainages to the Indian Ocean, and in tributaries to the Arabian Gulf.

In Arabia, based on Banister and Clarke's studies (1977), Cyprinion occurs in the coastal drainages and in the Ar-Rub'al-Khali Basin.

In Saudi Arabia, Based on our collections, the genus occurs in the Wadi Almhaleh of the Ar-Rub'al-Khali Basin and in Red Sea drainages. Our collections of Cyprinion were from different springs and streams in Khaybar, N. Al-Hijaz and Wadi Almhaleh southeast of Abha City. Cyprinion acinaces was collected from Khaybar springs. C. mhalensis was collected from Wadi Almhaleh in the Asir highlands. C. mhalensis is differentiated from any described species by a long intestine (about 5 times the standard length), number of scales (40-43) and other morphological characters.

Taxonomic Outline

Howes (1982) revised Cyprinion and recognized nine species including three Indian species formerly classified in the genus Semiplotus. According to Howes, the endemic Arabian species, C. acinaces retains the most primitive characters of all species in the genus.

Prior to Howes' publication, Berg (1949) recognized six species of Cyprinion: C. microphthalmum, C. macrostomum, C. irregulare, C. watsoni, C. milesi, and C. tenuiradius. Mirza (1969) synonymized C. irregulare with C. watsoni and claimed that C. microphthalmum could be distinguished by a three-chambered air bladder. However, on the basis of further study, Mirza (1971) concluded that the air bladder characteristic of two versus three chambers is not reliable for species recognition.

The latest revision by Howes (1982) recognizes nine species in the genus: C. acinaces (endemic to Arabia), C. macrostomum, C. kais (endemic to Tigres-Euphrates basin), C. milesi, C. watsoni, C. microphthalmum, C. semiplotum, C. modestum and C. burmanica. C. microphthalmum occurs in Arabian Gulf drainages of Iran and in Oman on the Arabian Peninsula (Scaphiodon muscatensis of Boulenger).

Prior to the publication of Banister and Clarke's work (1977), only Cyprinion microphthalmum was known from Arabia. Banister and Clarke (1977) described Cyprinion acinaces as a new species from Arabia. Our collections contain an additional species of Cyprinion.

Cyprinion acinaces Banister and Clarke, 1977

Cyprinion acinaces Banister, K. and M. Clarke. 1977. Jour. Oman Studies, Spec. Rep. (Sci. Results Oman Flora and Fauna Survey): p. 123.

Specimens Examined

Twenty specimens collected July, 1977, from Ain Al-Bhair, Khaybar, N. Al-Hijaz. 14 specimens collected July, 1977, from Ain Salaleem, Khaybar, N. Al-Hijaz. 12 specimens collected July, 1977, from Ain Ali, Khaybar, N. Al-Hijaz. 24 specimens collected July, 1981, from Ain Salaleem, Khaybar, N. Al-Hijaz.

Description

The shape of the body can be seen in Figure 5. According to Banister and Clarke's (1977) description:

"The mouth is ventral. The anterior edge of the lower jaw is gently curved and covered with a sharp-edged horny sheath. Barbels are short. Tubercles are present on the snout and interorbital region of some specimens. The eyes are lateral and visible in ventral view. The peritoneum is black. The skin between the pelvic fin base is fatty, thickened and papillose. The development of the thickened skin varies considerably. It is a heart-shaped patch of skin, although the papillae are continued onto the pelvic fin rays. At the other extreme, there are three flaps: there is a median, posteriorly directed flap laying between the pelvic fin bases, flanked on each side by a smaller flap which may cover the bases of the pelvic fins. The dorsal fin has four unbranched rays and 11-12 branched rays. The last unbranched ray is ossified into a long straight spine with a strongly serrated posterior face. The anal fin has three unbranched rays and seven branched rays.

In the lateral line there are 34-39 scales. Pharyngeal teeth number 2.3.4-4.3.2. Gill rakers are widely spaced, short, thin and slightly curved. On the lower limb of the first gill arch there are 8-12 gill rakers."

Specimens of this species possess the pronounced, scaleless bony ridge between the occiput and the origin of the dorsal fin similar to that seen in Cyprinion watsoni. The head is elongated. Mouth is of variable shape, i.e., horse-shoe, transverse or oblique. In some specimens the mouth contains a sharp curved blade in the lower jaw, while in yet others the cornified blade is weakly developed. The

lateral line is straight in some specimens, curved in others. Total lateral line scale counts range from 32 to 38. Scale counts to the end of the vertebral column range from 30 to 34.

There are 2-4 scales between lateral line and the pelvic fin. There are 14-17 scales around the least circumference of the caudal peduncle. There are 5-8 scales above the lateral line. In some specimens, there is a well-developed, fatty, thickened papillose skin between the bases of the pelvic fin, but other specimens have a less developed structure. Brown spots above the lateral line present in young disappear in adults. Tubercles appear on some male specimens. The stomach is well developed. The intestine length is from 2.44 to 3.75 times the standard length. The gas bladder has two chambers. Its posterior chamber is longer and slightly narrower than the anterior one. There are nine rays in the pelvic fin. The pectoral fin has 16 rays. Pectoral fins do not reach pelvic fins. Gill rakers on the first gill arch are short, stout and curved, their count ranges from 12-16. There are 20-27 gill rakers on the posterior side of the first gill arch. There are 23-28 gill rakers on the anterior side of the second gill arch. The caudal peduncle is narrow and short. The caudal fin is forked. The anus is immediately in front of the anal fin. Proportional measurements are presented in Table 2.

Coloration

Fresh specimens are gray dorsally, silver laterally, and silver ventrally. Preserved specimens are gray-brown dorsally, silver-gray or white-gray laterally. Dark brown spots are present above the lateral line in young specimens. These spots become obscure in older specimens.

Distribution

Previously, this species was known only from Wadi Hadramaut and in a stream at (or near) Taif, Saudi Arabia. Our collections extend the range to Khaybar drainages in Saudi Arabia (Figure 2) and we suggest that the Taif specimens may be C. mhalensis and not acinaces.

Relationships

Banister and Clarke (1977) were unsure of the affinities of C. acinaces. Howes (1982, figure 21) concluded that C. acinaces retains more primitive characters than does any other species in the genus. C. milesi and C. watsoni also share several primitive characters with C. acinaces. According to Howes, C. milesi is the closest living relative (sister species) of C. acinaces.

Cyprinion mhalensis, new species

D-IV-III 10, A III-7, L. L. 40-43

Specimens Examined

Holotype, no. 1 in collection of Arabian fishes, Department of Fishery and Wildlife Biology, Colorado State University, standard

length, 141 mm, collected July, 1977, from Wadi (Valley) Almhaleh Southeast Abha City (permanent stream). Paratypes-(no.2), five specimens collected from the same locality. Two specimens collected from Wadi Almhaleh were deposited in the National Museum of Canada, NMC 820109.

Description

Holotype (plus range)-Dorsal fin branched rays 10; anal fin branched rays 7; pectoral fin rays 17 (14-17); pelvic fin rays 9 (8-9); lateral line scales 43 (40-43); gill rakers on the anterior side of the first gill arch 16 (11-16). The shape of the body can be seen in Figure 6. The mouth is subterminal. The shape of the mouth is transverse, oblique. The anterior edge of the lower jaw is curved, often covered with a well developed blade. The blade in some specimens is not well developed, especially in small fish. The snout is blunt and short. the interorbital space is flat. There is one small pair of barbels. Tubercles are absent on the snout and interorbital region of the specimens examined. There is a well-developed bony ridge from the occiput to dorsal fin origin. The degree of the development of the bony ridge is more conspicuous in large specimens. Peritoneum is sooty black. No scales on ventral side. The eyes are lateral and visible in ventral view. The standard length is 3.8 times longer than the body depth. The standard length is 3.8 times longer than the head. The caudal peduncle length is 18% of the standard length. The caudal peduncle depth is 10% of the standard length. The stomach is well developed and muscular. The intestine is very long in one specimen; its length from the end of the stomach is 7 times the standard length,

while in other specimens the intestine is about 4 to 6 times the standard length. The air bladder is bipartite, its posterior chamber is longer and slightly more narrow than the anterior one. There is no flap between the bases of the ventral fin or only a weak development of a papillae-like structure.

There are 3 or 4 unbranched rays and 10 branched rays in the dorsal fin (last two counted as one). The last unbranched ray is ossified almost to the tip and strongly serrated all along the ossified segment. The dorsal fin origin is slightly anterior to the origin of the ventral fin. The dorsal spine length is shorter than the body depth.

There are 3 or 4 unbranched anal fin rays and 7 branched rays. The anal fin when laid flat does not reach the caudal fin. The anus is immediately in front of the anal fin.

Squamation. There are 40-43 (41.4) pored scales in the lateral line. There are 37-40 (38.4) scales to the end of the vertebral column. The lateral line is normally straight to the middle of the caudal peduncle, but in some specimens it is slightly curved. No scales on the bony dorsal ridge.

Gill Rakers. Gill rakers are short, slightly curved and thin. On the anterior side of the first gill arch there are 11-16 (13.1) gill rakers. On the posterior side of the first gill arch there are 21-32 (24.4) gill rakers. On the anterior side of the second gill arch there are 22-31 (26) gill rakers. Proportional measurements are given in Table 2. Two specimens, 72, 73 mm SL, from Wadi Nejran dam, collected by Dr. Naser Alassagh, 1982 were examined. These specimens

show the characters described above. The proportional measurements of these specimens expressed in thousandths of the standard length are: BD = 241, HL = 275, OL = 083, UjL = 083, DO = 516, DFBL = 186, DFDL = 275, BL = 055, CPD = 096, CPL = 199, AFDL = 185.

Coloration

Preserved specimens in alcohol are gray-brown dorsally and silver-gray below the lateral line. Dark brown patches are present above the lateral line in some specimens especially young fish. These patches disappear in mature fish.

Distribution

This species was collected from the Wadi Nejran dam and the Wadi Almhaleh, tributary to the Wadi Bishah of the Rub'al Khali basin southeast of Abha City (Figure 2). Banister and Clarke (1977) described four specimens of C. acinaces collected near Taif (probably in Rub'al khali basin) and three specimens listed as "Cyprinion incertae sedis" from a tributary to the Wadi Bishah (probably the Wadi Mhaleh) of the Rub al Khali basin. These seven specimens have 39 to 41 scales and six have 10 branched dorsal rays and one has 11. We believe these seven specimens discussed by Banister and Clarke are C. mhalensis. On the basis of present information, C. mhalensis is known only from the Rub'al Khali basin and C. acinaces from western and southern coastal drainages.

Etymology

The specific name is named for the type locality, Wadi Almhaleh.

Relationships

Cyprinion mhalensis appears to be closely related to C. acinaces. All collections to date indicate that C. mhalensis and C. acinaces are allopatric in distribution; C. mhalensis is known only from the internal Rub'al khali basin and C. acinaces from coastal drainages to the Red Sea. If future collections find mhalensis and acinaces to occur in sympatry, the recognition of mhalensis as a species would be validated. If populations exhibiting intermediate characters are found, mhalensis could be reduced to a subspecies of C. acinaces.

The major distinctions separating C. mhalensis from C. acinaces are fewer branched dorsal fin rays in mhalensis (10 vs. 12), and more scales in the lateral line (40-43 vs. 32-39). In comparison to specimens of C. acinaces, C. mhalensis has a greater relative length of the intestine and it lacks well developed skin flap between the pelvic fins.

C. mhalensis and C. acinaces most probably represent a divergence in Arabia after an ancestral species, probably close to C. milesi or C. watsoni, crossed the Arabian Gulf from Iran perhaps during the Pliocene or early Pleistocene.

Unknown Cyprinion

One specimen of Cyprinion was collected from an unnamed spring in Khaybar City in 1977. When this habitat was revisited in 1981 the

spring was dry. This specimen resembles Cyprinion mhalensis in the shape and the color of the body. It has the same number of dorsal and anal rays, the same number of scales, and in the possession of a strongly serrated spine in the dorsal fin. The major distinction between this specimen and C. mhalensis is the greater relative length of the intestine in C. mhalensis (4.0-7.0 vs. 2.7) and the longer more narrow caudal peduncle in this specimen. The specimen might be an aberrant C. mhalensis or a subspecies of mhalensis or, perhaps, a new species. More specimens will be necessary before a decision can be made. Proportional measurements of this specimen are presented in Table 2.

Cyprinion microphthalmum (Day, 1880)

Scaphiodon microphthalmus Day, 1880, Proc. Zool. Soc.

London:227.

Scuphiodon muscatensis Boulenger, 1887, Proc. Zool. Soc.

London:665.

Cyprinion microphthalmum Berg, 1949, Trudy Zool. Inst. Leningr.

8(4):817

A species of Cyprinion indigenous to Oman was the first freshwater fish formally described from Arabia. Boulenger (1887) named a new species, Scaphiodon muscatensis for this fish. Without examining any Arabian specimens, Berg (1949) synonymized muscatensis with Cyprinion microphthalmum. Banister and Clarke (1977) and Howes (1982) tentatively identified the Oman Cyprinion as C. microphthalmum but these authors recognized that some doubt will remain concerning the specific identity of the Oman Cyprinion until critical comparisons are made between specimens from Oman and specimens of C. microphthalmum from the type locality area (near Quetta, Pakistan).

Banister and Clark gave the following diagnosis of the Oman Cyprinion, based on 13 specimens: branched dorsal rays, 9-11; branched anal rays, 7; 33-39 lateral line scales; 8-10 gill rakers on the lower limb of the first gill arch.

As far as known, the distribution of this species in Arabia is restricted to a small area near the city of Muscat (Banister and Clarke op. cit., Howes op. cit. Haas 1982).

Table 2. Proportional measurements of Cyprinion specimens expressed in thousandths of the standard length.

Measurements	<u>C. acinaces</u> (N=46)		Holotype	<u>C. mhalensis</u> (N=8)		Unknown <u>Cyprinion</u> from Khaybar City	<u>C. acinaces</u> from Ain Salaleem (N=24)	
	\bar{X}	Range		\bar{X}	Range		\bar{X}	Range
SL	78.3	50-117	141	85.5	55-141	124	91	70-135
BD	291	250-341	262	264	237-345	202	264	231-286
HL	286	256-316	241	269	241-280	242	272	253-314
OL	075	060-100	049	076	049-098	065	074	067-086
UJL	076	055-091	064	075	065-091	065	074	059-087
DO	515	419-560	518	522	500-545	524	519	460-557
DFBL	229	205-263	191	199	180-218	202	239	204-281
DFDL	319	274-368	262	261	237-291	290	309	228-355
BL	050	028-083	035	039	028-055	024	046	037-057
CPD	105	083-125	099	103	093-127	064	105	084-119
CPL	170	145-200	163	178	148-206	194	136	114-159
AFDL	193	159-250	248	212	164-248	210	---	---
IL*	3.10	2.44-3.75	6.99	5.29	3.95-6.99	2.7	---	---

*Actual ratio of intestine length to standard length.

Genus Garra Hamilton

Garra Hamilton, 1822, Fishes of the Ganges, Edinburg, p. 343,

(type: Gyprinus lamta).

"Mouth transvers. Lips continuous covered with anterior and posterior labial folds. Jaws covered with horny sharp edge. Snout more or less rounded or slightly conical. Barbels generally four, sometimes two. Pharyngeal teeth three closely set rows: the inner 5 or 4, the middle 4 or 3, the outer 3 or 2. The typical number is 2.4.5-5.4.2. scales of moderate size. Dorsal fin with 9 to 12 rays, 6 to 9 of which branched (II,6-III,9) originating in advance of pelvics. Anal fin short with 6 to 8 rays (I,5-III,5), pectoral fin with I-II, 17 rays. Lower lip modified into a suctorial disc with free anterior and posterior margins. Gill rakers widely set, short and few. Air bladder varies in form and extent." (Menon 1964).

Distribution

The genus Garra is widespread from South China and Borneo in the east, through Burma, India and Ceylon, Afghanistan, Iran, Syria and Arabia to Somaliland, Ethiopia, East Africa and then southward to Guinea through the Congo (Menon 1964).

Taxonomic Outline

The genus Garra was described by Hamilton in 1822 based on Cyprinus lamta. Heckel (1843, 1844) described several species under a new genus, Discognathus from Iraq, Syria, and Iran. Günther (1868) listed D. lamta, D. macrochir, D. variabilis, and D. nasutus in his "Catalogue of Fishes in the British Museum". Günther, Playfair and Blanford referred to D. lamta specimens from Afghanistan, Arabia, and Ethiopia respectively (Menon 1964).

Berg (1949) revised this group and divided it into two genera, Garra (two pairs of barbels) and Discognathichthys (= Discognathus) (one pair of barbels). Berg also pointed out that the sucking disc in Discognathus is fused at the anterior margin, whereas it is free in Garra. Berg recognized two species of Discognathus: D. variabilis and D. rossica. Menon (1964) included Discognathus as a species group of Garra. Menon's arrangement of Garra is as follows:

- a) The variabilis group (= Discognathus) Garra variabilis and G. rossica are the only species in this group. Saadati (1977) found an undescribed species in Iran.
- b) Gotyla group. G. gotyla, G. rhynchota and G. nasuta are the only species in this group.
- c) Tibanic group. This group involved seven complexes and 28 species. According to Menon (1964), the Garra species of Arabia, Iraq, Iran and Syria belong to the "rufa" complex of the "tibanica" group which consists of G. tibanica of Arabia, G. rufa obtusa from Iraq and Iran and G. barreimiae from Arabia. Menon (1964) pointed out that Garra arabica, Hora 1921 is actually Garra nasuta (an Indian species).

Banister and Clarke (1977) recognized three species of Garra in Arabia:

- 1) Garra barreimiae Fowler and Steinitz, 1956.
- 2) Garra longipinnis Banister and Clarke, 1977.
- 3) Garra tibanica Trewavas, 1941.

They recognized two subspecies of G. barreimiae, Garra barreimiae barreimiae and Garra barreimiae shawkahensis. They agreed with Menon (1964) in aligning G. barreimiae with G. rufa, which is widely spread between the Mediterranean and the Tigres-Euphrates System. They related G. longipinnis with G. barreimiae. Krupp (1982) recognized two subspecies of G. tibanica, G. tibanica tibanica (in Arabian coastal basin) and G. tibanica ghorensis (in southern Dead Sea Valley, Jordan).

Our collections in 1977 from western Saudi Arabia contain Garra tibanica from the Wadi Almhaleh and from one spring in Khaybar City. Our collections in 1981 extended the range of the genus to Wadi Hediah to the west of Khaybar City and Alwastah, a village southwest of Almadinah (Figure 2).

Garra tibanica Trewavas, 1941

Discognathus lamta: Playfair, 1870, Proc. Zool. Soc., London:85 (not Hamilton 1822).

Garra tibanica Trewavas, 1941, British Museum (Natural History) Expedition to southwest Arabia 1937-8, I(3):8.

Garra brittoni Trewavas, 1941, British Museum (Natural History) Expedition to southwest Arabia 1937-8, I(3):11.

D III 7, A III 5, L. L. 30-36, P. 14-16, v. 8-10.

Specimens Examined

Two specimens, 73-86 mm SL were collected July, 1977, from Wadi Almhaleh, southeast of Abha City.. Seven specimens, 38-71 mm SL, were

collected July, 1977, and July, 1981, from Ain Aljmyma, Khaybar, Saudi Arabia. Six fish, 89-115 mm SL, were collected July, 1981, from Wadi Hediah. Wadi Hediah is located at about 80 km west of Khaybar, Saudi Arabia. One fish, 58 mm SL, was collected July, 1982, from Wadi Nejran dam, Nejran, Saudi Arabia.

Description

Banister and Clarke (1977) listed this species from different localities in Arabia (Figure 2). They based their description on 93 specimens, 46-110 mm SL. According to their description,

"The snout is blunt and distinctly wedge-shaped in dorsal view, pointed in side view. Most specimens possess horny tubercles on the sides and top of the snout. The mental disc is variable in shape. The anus is immediately in front of the anal fin. the dorsal fin has three or four unbranched rays; the last unbranched ray is not ossified. There are six, seven or eight branched rays. The anal fin has three unbranched rays and five branched rays. The lateral line has 30-36 scales. Around the least circumference of the caudal peduncle there are 12 to 20 scales. the pharyngeal teeth number 2.4.5-5.4.2 in all specimens examined. The gill rakers are short and widely spaced. On the lower limb of the first gill arch there are 6-17 gill rakers.

The specimens collected in 1977 and 1981 are similar to the description given by Banister and Clarke. According to our specimens the lateral line is straight, the caudal peduncle is elongated. Brown spots present on the 3rd, 4th, 5th, and 6th rays of the dorsal fin. There are two pairs of barbels. In some specimens tubercles are absent. In one specimen (75 mm SL) the mental disc width is 7 mm while its length is 6 mm. Proportional measurements are presented in Table 3.

Table 3. Proportional measurements of Garra tibanica, expressed in thousandths of standard length.

Measurements	Ain Aljmyma (N=7)		Wadi Hediah (N=6)		Wadi Nejran (N=1)	Wadi Almhaleh (N=2)	
	\bar{X}	Range	\bar{X}	Range		\bar{X}	Range
SL	46.5	38-71	102	89-115	58	79.5	73, 86
BD	219	197-250	216	203-224	207	213	221, 205
HL	306	267-386	248	243-255	241	277	279, 274
OL	068	044-091	048	035-056	068	063	058, 068
UJL	115	099-136	080	071-101	052	095	093, 096
DO	527	488-659	486	459-500	500	492	476, 507
BL	062	042-083	043	039-046	052	038	035, 041
DFDL	255	250-318	266	243-276	240	214	209, 219
DFBL	144	125-182	137	117-153	121	151	151, 151
CPD	108	099-119	125	087-222	103	105	105, 105
CPL	201	176-250	165	146-185	172	158	151, 164
HD	580	533-682	502	483-524	552	578	581, 575
IOW	128	100-159	112	104-124	121	129	129, 129
Snt-L	137	125-159	104	101-111	121	125	120, 130
PFL	217	197-250	215	200-245	241	205	200, 210

Coloration

The color is dark gray above, paler below. Dark spots at bases of the 3rd, 4th, 5th, 6th and 7th dorsal fin rays (branched) and a dark-brown spot behind the upper angle of the gill opening.

Distribution

This species is widely distributed along the coastal drainages of west and southwestern Arabia. It occurs in Wadi Hadhramaut, Wadi Almhaleh southeast of Abha, Ain Aljyma in Khaybar City, Wadi Hediah, and Wadi Nejran (Figure 2). Krupp (1982) recorded its occurrence in the southern Dead Sea Valley, Jordan.

Relationship

Garra tibanica shows considerable range in various meristic and morphometric features. For example, the gill rakers on the lower limb of the first gill arch range from 6 to 17, whereas Menon (1964) gave the range as 9-12.

Trewavas (1941) considered tibanica to be closely related to Garra blanfordii, a species of eastern Ethiopia. Menon (1964) concluded that G. tibanica is most closely allied to G. quadrimaculata of Ethiopia, but the latter differs in the more anterior position of the anus.

Banister and Clarke (1977) wrote: "Within the tibanica complex, there are two species from northeast Africa that have some significant similarities with Garra tibanica. In Garra makiensis (Boulenger) and Garra ethelwynnae Menon, the anus is close to the anal fin and the body shape and the color pattern are the same as Garra tibanica.

According to Menon (1964) Garra rufa resembles Garra tibanica even though they are well separated geographically. Garra longipinnis can easily be separated from G. tibanica by its thin body and very long paired fins, while G. barreimiae can be separated by its mottled pattern and the position of the vent (Banister & Clarke 1977).

Balletto and Spano(1977) examined 456 specimens from several localities in Southern Yemen. In an example of statistical overkill, they described 9 subspecies of G. tibanica.

Garra barreimiae Fowler and Steinitz

Garra barreimiae Fowler and Steinitz, 1956, Bull. Res. Coun. Israel, 513(3-4):262-263.

G. barreimiae is known only from the drainages flowing from the Alakhdar Mountains to the Arabian Gulf and to the Gulf of Oman. Based on Banister and Clarke's (1977) description, large specimens possess a wedge-shaped snout. The snout bears distinctive patches of horny tubercles. The mental disc is wider than it is long and more constant in form than in G. tibanica. The anus is further from the anal fin in G. barreimiae than in G. tibanica. There are 4 unbranched and 6 to 8 branched dorsal rays. The anal fin has 3 unbranched and 5 branched rays. The lateral line has about 33 scales. Banister and Clarke agreed with Menon (1964) in aligning G. barreimiae with Garra rufa, a widely distributed species between the Mediterranean and the Tigris-Euphrates basin. They described a new subspecies, Garra barreimiae shawkahensis. G. b. barreimiae is restricted to drainages

flowing to the Gulf of Oman and to the Oasis of Baraimi. G. b. shawkahensis is confined to the Wadi Shawkah which drains the northwest slopes of Alakhdar Mountains towards the Arabian Gulf.

Garra longipinnis Banister and Clark, 1977

G. longipinnis Banister and Clark (1977). Oman. Jour. Studies, Spec. Rep. (Sci. Results. Oman Flora and Fauna Survey): p. 137.

This species was described by Banister and Clark (1977) from the village of Saiq, Oman. Based on their description, the body is thin and the paired fins are long. The mental disc is well developed. There are 4 unbranched and 6 to 7 branched dorsal rays. There are 3 unbranched and 5 branched anal rays. The lateral line has 29 to 31 scales. There are 13-14 gill rakers on the lower limb of the first gill arch. Gill rakers are short and widely spaced. The authors suggested the close relationship between this species and Garra barreimiae based on the development of the mental disc, the rounded shape of the snout in side view and a similar anus-anal fin distance (4-6% SL).

Unknown Garra

One specimen of a probable undescribed species of the genus Garra was collected from a spring at Alwastah, Southwest of Almadinah.

All characters are similar to Garra tibanica except this specimen has a deeper body (26.1% SL vs. 21.9), and small papillae on the anterior part of the mental disc. These papillae are not found on the

posterior part. More specimens must be examined from this locality to determine the status of this fish as a new species or as an aberrant form of G. tibanica.

Genus Acanthobrama Heckel

Acanthobrama Heckel, 1843, in Russegger's Reisen, P. 1033.
(Type; A. marmid).

The genus is distinguished from other Arabian cyprinids by a keel on the belly between the pelvic fin and the anus; pharyngeal teeth 5-5 or 5-4; 51-100 scales in the lateral line and scales without radii on the anterior field (Coad et al. in press, Goren et al. 1973). Steinitz (1952) described a new species, Acanthobrama terraesanctae from Lake Tiberias. This species was made the type of a new genus, Mirogrex by Goren et al. (1973). Howes (1981) synonymized Acanthobrama and Mirogrex with the genus Rutilus. Coad et al. (in press) regarded Mirogrex as a synonym of Acanthobrama, but retained the generic status of Acanthobrama. The five previously known species of this genus are found in the Tigris-Euphrates basin and the Jordan River. Specimens identified as Acanthobrama in Saudi Arabia were collected from Ain (= spring) Aljyma and Wadi Hediah during 1977 and 1981 (Figure 2.).

Because of the significance of this find and our lack of comparative museum specimens of Acanthobrama necessary for a proper formal description of a new species, we sent the specimens to Dr. Brian Coad of the National Museum of Canada. We will coauthor the description of the Arabian Acanthobrama with Dr. Coad, to be published in 1983.

FAM. CYPRINODONTIDAE (TOOTH-CARPS)

This is a very large family commonly called "top minnows" or "tooth-carp." Typically small fish (100 mm). Upper surface of the head is usually flattened. Mouth is terminal, specialized for feeding on surface. No barbels. No adipose fin. Swim bladder without duct. Fins spineless.

Aphanius dispar (Ruppell, 1828)

Lebias dispar Ruppell, 1828. Atlas zu der Reise in Nordlichen Afrika, 4. Fische des Rothen Meers:66.

D I-7 or II-7, A I-8 or II-7, L. L. 26-28, P. 13-14

A total of 93 specimens were examined. They ranged from 30 to 60 mm SL. This species appears to be the most widely distributed species in Arabia (Figure 2). This distribution is due to the salinity tolerance of cyprinodont fishes which allows movement through the sea. Members of this species are sexually dimorphic. Specimens rarely reach 80 mm. In the adult male, the dorsal fin is twice as high as that of the adult female. Aphanius dispar exhibits considerable variation in the specimens examined. They have 13-16 gill rakers on the anterior side of the first arch and 15-23 gill rakers on the posterior side of the first arch. There are 26-28 scales in the lateral line. The dorsal fin has two unbranched rays and seven branched rays. The anal fin has eight rays. In the male, the dorsal profile is arched. Pectoral fins overlap pelvic fins, pelvic fins overlap anal fin. Fins are long and pointed. Dark blue speckles occur on the

dorsal and anal fins of the male. Males are brightly colored, brown to dark blue, with numerous irridescent, blue-silver blotches in rows on the flanks and weak brownish transverse bars above the caudal peduncle. Dorsal and anal fins with silvery blotches and dark spots. Pectoral and pelvic fins are yellow. Females are gray with a bluish-silver sheen. Numerous transverse bars on the flank. Fins are small and rounded in female. In all specimens, teeth are tricuspid. Peritonium black. The stomach is well developed. The presence of this species in the eastern regions and Alkharj has not been mentioned before. Haas (1982) discussed some aspects of the natural history of A. dispar in Oman.

FAM. POECILIIDAE

Viviparous, more than 25 genera in North and South America. Anal fin of the male produced, its 3rd, 4th and 5th rays modified into a copulatory organ.

Gambusia affinis (Baird and Girard)

D 6 (last two rays taken as one), A 8-9, L.L. 28-30.

Two specimens SL 34 and 36 mm were collected from a spring in Alkharj City (Figure 2). G. affinis is a small fish, seldom exceeding 60 mm. The gill rakers number 12-14. The dorsal fin has six rays. The lateral line scales range from 28 to 30. The genus Gambusia has been introduced throughout the world to control the mosquito vector of malaria. This is the first record of the species in

Saudi Arabia. There should be a general awareness in Saudi Arabia concerning the potential danger that introductions of exotic species have for native species and for disruptions of ecosystems. Thus, it is important to complete a comprehensive survey of Arabian fishes to document the occurrence and status of all native species in order to better protect them from habitat destruction and non-native fish introduction. The native "top minnow," Aphanius dispar, can probably act as an effective biological control for mosquitoes. Saadati (1977) pointed out that G. affinis had replaced Aphanius from much of the range in Iran. Al-Daham et al. (1977) discussed interaction between Gambusia and three species of Aphanius in southern Iraq. In the future, we urge that native species should be given priority for introductions.

DISCUSSION

A total of 208 specimens were examined from different localities of eastern, northwestern and southwestern Saudi Arabia. The most common and ubiquitous species, Aphanius dispar, made up most of the total numbers of specimens.

Our collections made in 1977 and 1981, although restricted to Saudi Arabia, represent the most extensive sampling of freshwater fishes yet made from the Arabia Peninsula. Besides the species described by Banister and Clarke, a new species of the genus Cyprinion (C. mhalensis), the first record of the genus Acanthobrama and probable undescribed species of Barbus and Garra are recorded.

Although no fish collections have yet been made in vast regions of Arabia and much is yet to be learned, some general conclusions can be made. It appears that the original African fish fauna existing up to the time of the initiation of the Red Sea rift in the Miocene were completely eliminated. Virtually all species of primary freshwater fishes now known in Arabia are endemic species. This fact indicates long isolations.

The genus Cyprinion is of Asiatic origin and is represented by one non-endemic and two endemic species. It is probable that C. acinaces and C. mhalensis are the result of divergence from a common ancestor in Arabia. The ancestral species is assumed to have moved across the Arabian Gulf from Iran during an early period of low ocean levels and a Gulf freshwater environment. Cyprinion microphthalmum native to Oman appears to represent the most recent and least differentiated invader from Iran that moved across the Gulf during a later glacial epoch and did not have the opportunity to disperse eastward from Oman.

The genus Garra, also of Asiatic origin, crossed the Arabian Peninsula to become established in northeast Africa. Garra is represented by three known endemic species. There is a question concerning Garra tibanica as an endemic Arabian species. Menon (1964) recorded G. tibanica from Somalia. There is such variability and diversity in Menon's "tibanica complex" that we consider the identification of Somalian specimens as G. tibanica, at best, doubtful in relation to the time of isolation.

The three, possibly four, endemic species of Arabian Barbus suggest two ancestral origins. B. apoensis is most probably derived

from an ancestor associated with the B. canis-B. luteus group invading from the north (Jordan R.) or from the east (Tigres-Euphrates or Mond R.).

B. arabicus and B. exulatus are most likely derived from an ancestral member of the Barbus intermedius complex, invading across the southern end of the Red Sea during a period of freshwater connections from northeast Africa. Acanthobrama seems clearly to have invaded the western Arabian Peninsula from the Jordan River basin.

Aphanius dispar, because of its ability to disperse through seawaters, does not represent ancient relict populations divergent from the parent species. The present distribution of Aphanius is assumed to be of late Pleistocene origin, when presently isolated internal basins had direct outlets to surrounding seas.

In Arabia, no fish collections have yet been made from the ArRumah (= Al-Batin), Euphrates and As Sirhan basins. The other basins have not been extensively collected. Much is yet to be learned on the freshwater fishes of Arabia.

Ichthyological studies can be of critical significance for interpretation of the climatic and hydrographic history of the country. Also, freshwater fish can become a more important part of the Arabian economy by increasing the supply of protein, by providing recreational and esthetic values and perhaps as biological control agents. However, introductions of non-native species without suitable planning and evaluation of all possible ramifications can cause ecological catastrophies.

Utilization of native fishes to serve national interests should be given priority. A continuation of the present study is necessary

to complete the documentation of species, their distribution and habitats before extinction caused by water development projects occurs. Our study on the freshwater fish fauna of Saudi Arabia emphasizes the need for a national awareness to preserve all native plants and animals and develop an environmental conscience to protect the nation's biological heritage.

The prophet Muhammad urges the nations to be merciful and helpful to all of God's creatures. Thus, the development of an environmental conscience has a basis in the religious and cultural heritage of Islam. Abu Huraira tells us that Allah's Apostle said: "While a man was walking on a road, he became very thirsty. Then he came across a well, got down into it, drank of its water and then came out. Meanwhile, he saw a dog panting and licking mud because of excessive thirst. The man said to himself, "This dog is suffering from the state of thirst as I did". So he went down the well (again) and filled his shoe (with water) and held it in his mouth and watered the dog."

Allah thanked him for that deed and forgave him. The people asked, "O, Allah's Apostle! Is there a reward for us in serving animals?" He said, "Yes, there is a reward for serving any living being."

The original Arabic text is as follows:

*Sahih Al-Bukhari, 2nd edition, 1977, Vol. VIII, Hilah Yayinlari, P.O. Box 448, Ankara, Turkey.

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Figure 1. Major drainage basins of Arabian Peninsula.

Figure 2A. Distribution of freshwater fishes: Barbus apoensis (■), B. exulatus (▲), B. arabicus (●), Aphanius dispar (☼), Gambusia affinis (♣), Acanthobrama sp. (●).

Figure 2B. Distribution of freshwater fishes: Cyprinion microphthalmum (☼), C. acinaces (■), C. mhalensis (●), Garra tibanica (▲), G. barreimiae barreimiae (●), G. b. shawkahensis (♣), G. longipinnis (□), Garra sp. (★).

Figure 3. Barbus apoensis, 176 mm SL (adapted from Banister and Clarke 1977).

Figure 4. Unknown Barbus, 81 mm SL.

Figure 5. Cyprinion acinaces, 110 mm SL.

Figure 6. Cyprinion mhalensis, 141 mm SL (A). Cyprinion of uncertain identity, 124 mm SL (B).

Figure 7. Garra tibatica, 78 mm SL.

Figure 8. Acanthobrama sp. 75 mm SL.

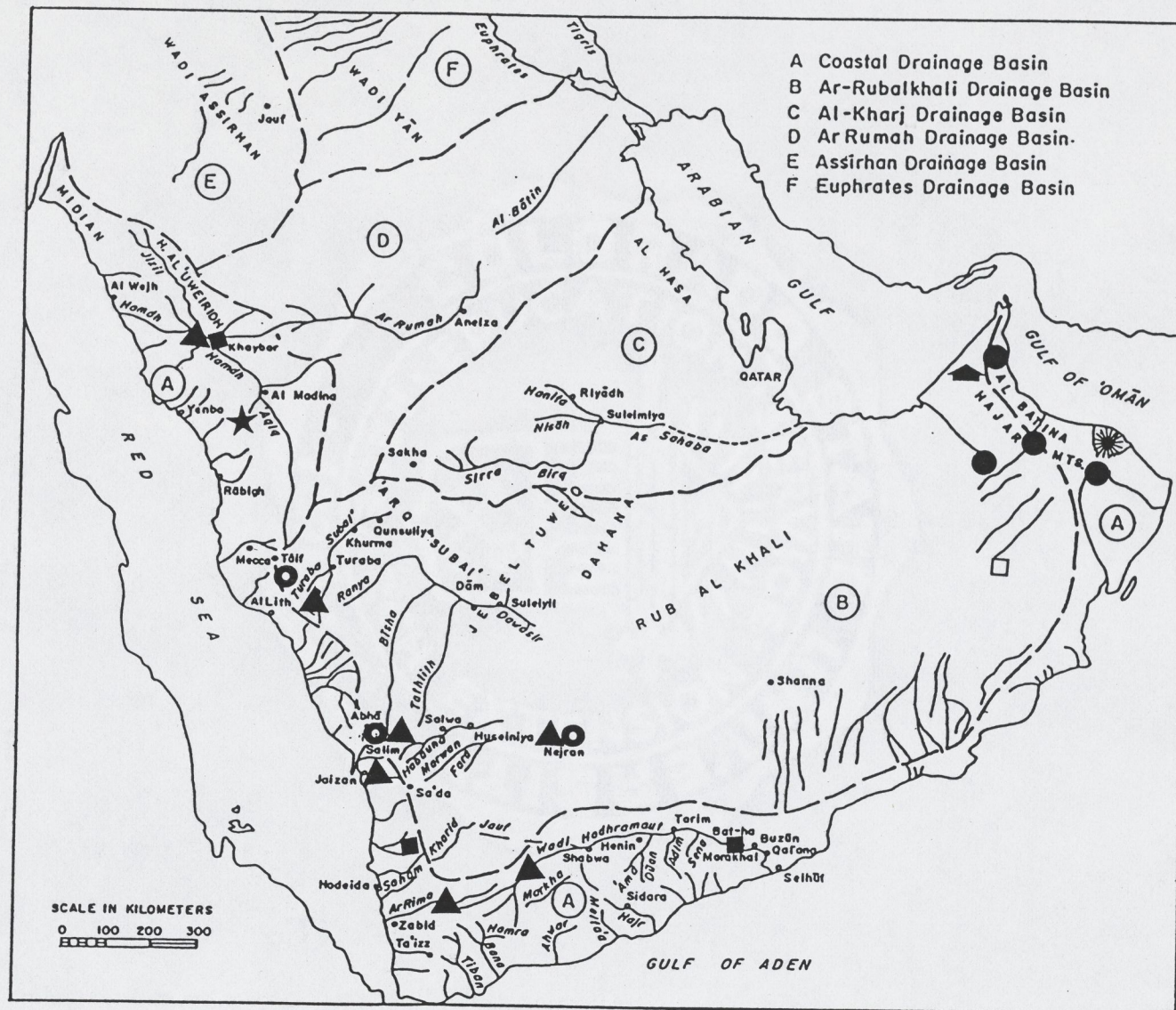


Fig. 2B

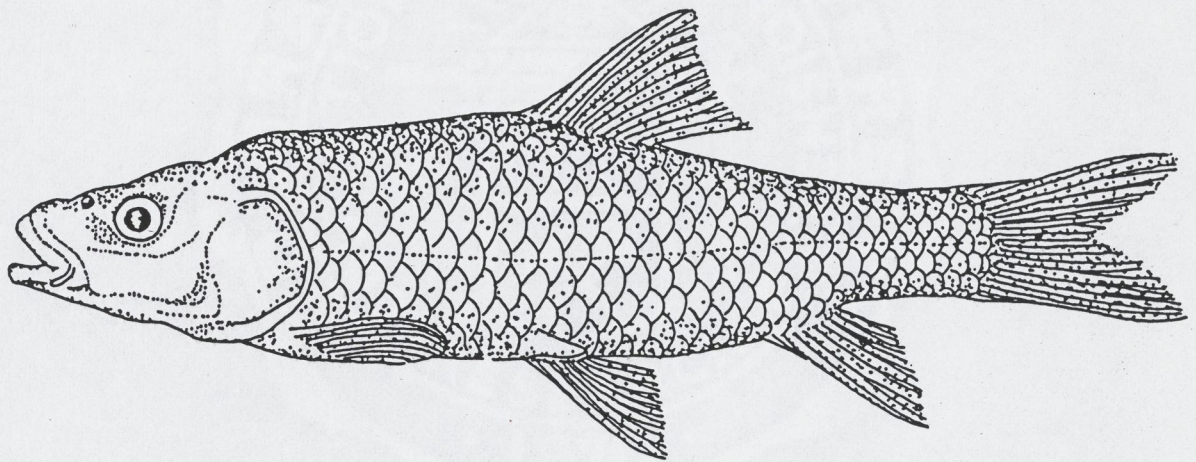


Fig. 3

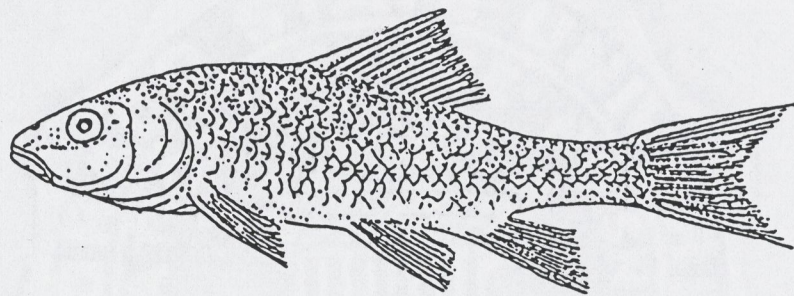


Fig. 4

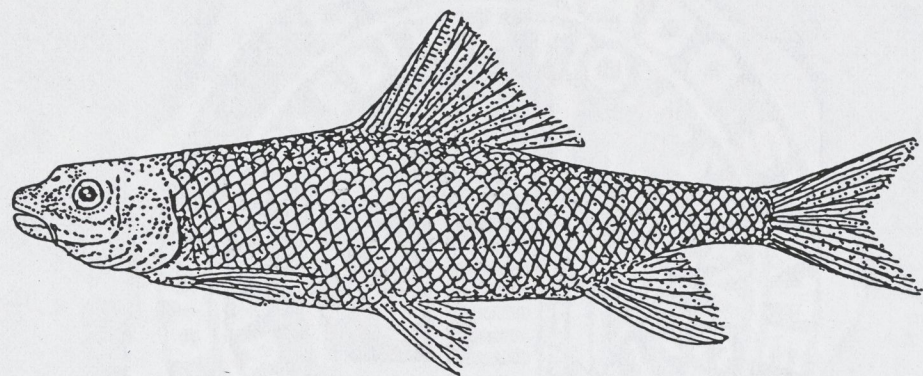
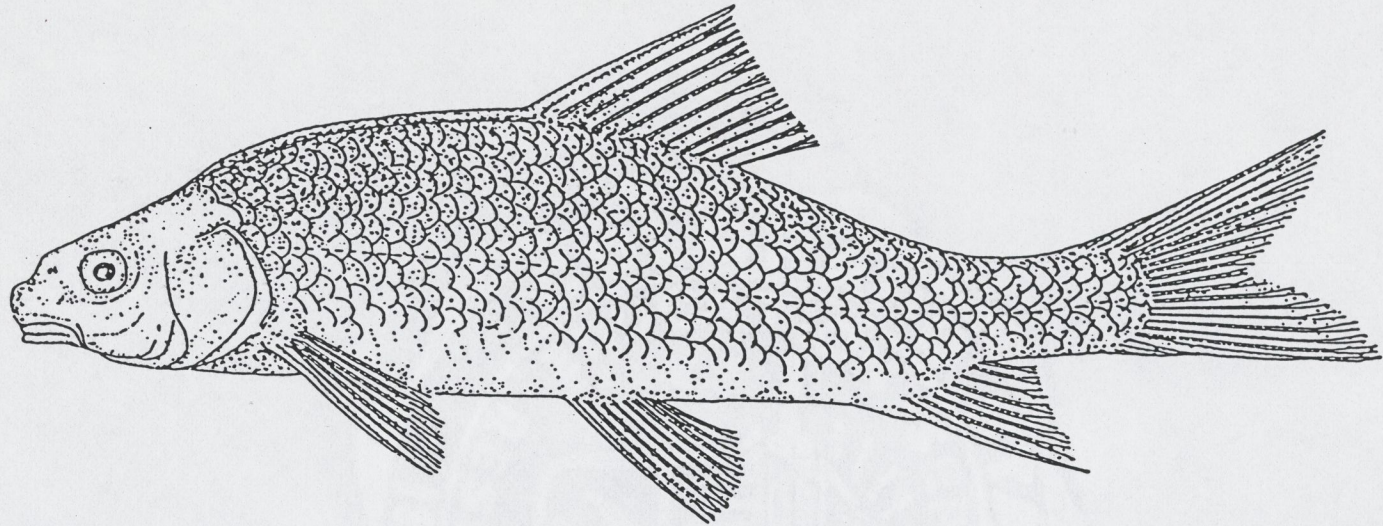


Fig. 5

A



B

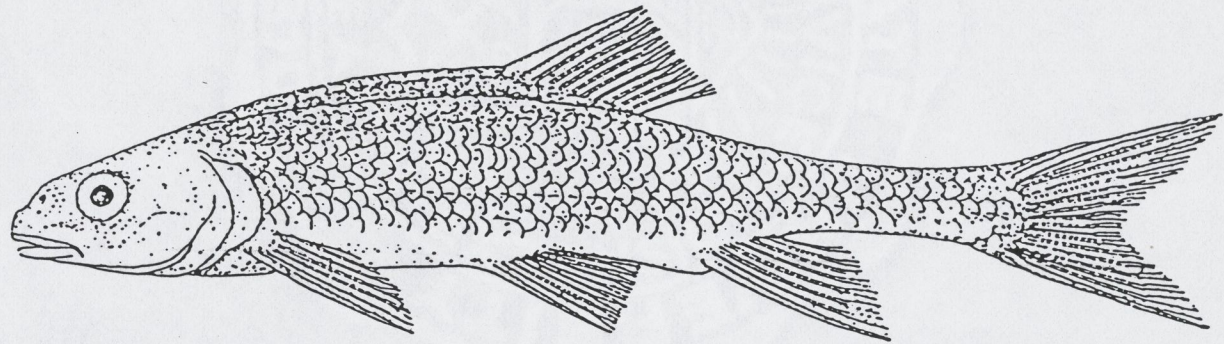


Fig. 6

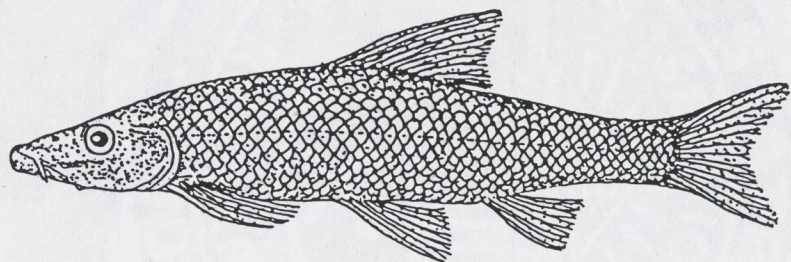


Fig. 7

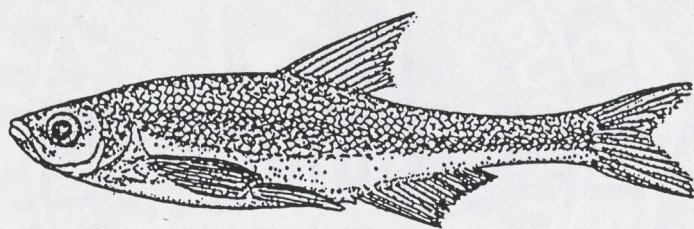


Fig. 8

حدَّثَنَا إِسْمَاعِيلُ : حَدَّثَنِي
مَالِكٌ ، عَنْ سُمَيِّ مَوْلَى أَبِي بَكْرٍ ، عَنْ
أبي صالح السَّمانِ ، عَنْ أَبِي هُرَيْرَةَ :
أَنَّ رَسُولَ اللَّهِ صَلَّى اللَّهُ عَلَيْهِ وَسَلَّمَ قَالَ :
بَيْنَمَا رَجُلٌ يَمْشِي بِطَرِيقِ اشْتَدَّ
عَلَيْهِ الْعَطَشُ ، فَوَجَدَ بَيْتْرًا فَتَنَزَّلَ فِيهَا
فَشَرِبَ ، ثُمَّ خَرَجَ فَإِذَا كَلْبٌ يَلْتَهُ
بِأَكْلِ التَّرَى مِنَ الْعَطَشِ ، فَقَالَ الرَّجُلُ :
لَقَدْ بَلَغَ هَذَا الْكَلْبُ مِنَ الْعَطَشِ
مِثْلُ الَّذِي كَانَ بَلَغَ بِي ، فَتَنَزَّلَ الْبَيْتْرُ
فَمَلَأَ خُفَّهُ ، ثُمَّ أَمْسَكَهُ بِفِيهِ فَسَمِيَ
الْكَلْبُ ، فَشَكَرَ اللَّهُ لَهُ فَغَفَرَ لَهُ .
قَالُوا : يَا رَسُولَ اللَّهِ ، وَإِنَّ لَنَا فِي الْبَهَائِمِ
أَجْرًا ؟ فَقَالَ : فِي كُلِّ ذَاتِ كَبِدٍ رَطْبَةٌ
أَجْرٌ .

NEW INFORMATION ON THE FRESHWATER FISHES OF THE ARABIAN PENINSULA

by Hmoud Fares AlKahem and Robert J. Behnke

ABSTRACT

This work is the first comprehensive scientific collection and report on freshwater fishes from Saudi Arabia. Three new species of the genus Cyprinion (C. mhalensis, C. nemus, C. niger) are described.

The first record of a non-native fish (Gambusia affinis) from Saudi Arabia is given. Several new distributions are recorded.

Comprehensive appraisal of geological, geographical and climatic events correlated with zoogeographical evidence and interpretation of degree of divergence in living species is utilized to provide an interpretation of factors explaining the present distribution and taxonomy of freshwater fishes.

Cultural and religious bases are presented as a rationale for preserving and protecting the native fishes of Saudi Arabia as a part of Arabia's biological heritage.

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* Note can mention Bentzen's discovery of new sp. cave fish fr. Oman
* Haves letter re: Cyprinion

INTRODUCTION

The Arabian Peninsula consists of several nations. The largest is the Kingdom of Saudi Arabia, which occupies some four-fifths of the Arabian Peninsula (= Arabia).

During the early Cenozoic, Arabia was part of a continuous African-Asiatic land mass. From the middle to the end of this era an erosional process increased as a result of land movements causing an opening of the Arabian Gulf at the strait of Hormuz connecting the Gulf to the Indian Ocean (Abualula 1975). During the Miocene the Red Sea was an arm of the Mediterranean Sea or the Tethys Sea. At that time the Red Sea was separated from the Indian Ocean, but in the beginning of the Pliocene, the land surface was raised, as a result of which the Red Sea became isolated from the Mediterranean-Tethys Sea and the Strait of Babalmandeb was formed connecting the Red Sea to the Indian Ocean.

Freshwater fishes are the best evidence of past land connection with Arabia serving as a bridge between northeast Africa and Asia, because primary freshwater fishes (mainly of order Cypriniformes) are restricted to freshwater and can only disperse by freshwater routes.

Virtually nothing is known of freshwater fishes of Arabia. Berg's (1934) map of fish zoogeography has a question mark (?) on the Arabian Peninsula. The literature of freshwater fishes of Arabia is very sparse. Boulenger (1887) described a new species of cyprinid fish from Muscat on the east coast of Arabia. Trewavas (1941) described three new species of cyprinids based on collections from southwest Arabia. Fowler and Steinitz (1956) described a new cyprinid species from Oman. The most comprehensive work regarding freshwater fishes of the Arabian Peninsula with the first mention of freshwater fish from Saudi Arabia is the study of Banister and Clarke (1975). They recognized nine species of three genera of the "minnow" family Cyprinidae and one species of the "top minnow" family Cyprinodontidae. All except one of the cyprinid species are considered endemic to Arabia, indicating the long isolation of most of Arabia from direct freshwater access routes of dispersal.

Our collections made in 1977, although restricted to Saudi Arabia, represent the most extensive sampling of freshwater fishes yet made on the Arabian Peninsula. We found all of the species described by Banister and Clarke from Saudi Arabia plus three new species of Cyprinion. The first record of the American mosquitofish, Gambusia affinis (Poeciliidae), from Arabia was found in our collections.

It is important that further studies be initiated soon to increase the knowledge of the freshwater fish fauna before industrial and agricultural development occur on a large scale and inalterably change or destroy the fragile freshwater habitats. Groundwater pumping has already dried springs in some areas. Water development projects will dramatically alter much of the present aquatic habitats and exotic fish species will likely be introduced. Unless the present fish fauna is studied and documented, species may become extinct before they were known to exist.

Figure 1 illustrates six separate drainage basins based on the topography of the Peninsula. It is assumed that during major pluvial periods, all drainages within any one of the present internal basins would have been interconnected, allowing the opportunity for dispersal of fishes throughout a basin. Specimens are presently maintained in the fish collection of the Department of Fishery and Wildlife Biology, Colorado State University.

PREVIOUS STUDIES OF FRESHWATER FISHES OF ARABIA

The first mention in the literature of freshwater fish from Arabia was by Boulenger (1887) who described a new species, Scaphiodon muscatensis, from Muscat. Berg (1949) synonymized Scaphiodon muscatensis with Cyprinion micropthalmum, a widespread species in Iran and Pakistan.

No additional reference to Arabian freshwater fishes was published until Trewavas (1941) described three new species: Barbus arabicus, Garra tibanica, and Garra brittoni and recorded the occurrence of Aphanius dispar (Cyprinodontidae) from Yemen, based on collections made by The British Museum of Natural History Expedition to Southwest Arabia, 1937-38.

Fowler and Steinitz (1956) described a new species, Garra barreimiae, from Oman.

The most recent and comprehensive publication on the Arabian freshwater fishes is by Banister and Clarke (1975) in which collections from Saudi Arabia are mentioned for the first time.

They list nine species: eight cyprinids and one cyprinodont: four of the cyprinids are described for the first time--Barbus apoensis, Barbus exulatus, Cyprinion acinaces and Garra longipinnis.

Van Convering (1977) mentioned fossil cichlids (family Cichlidae) and Barbus-like material of unknown age from Ad Darb, Red Sea coast. Brown (1970) mentioned Miocene fossil of Barbus in Jaizan basin on Tihama north of the Yeman boundary. Figure 1 illustrates the known distribution of all species plus distribution of three new species of the genus Cyprinion.

FAMILY CYPRINIDAE

Upper jaw margined, as a rule. Barbels if present not more than 2 pairs (4 pairs only in Gobiobotia (Berg 1949)). Swimbladder usually free, not enclosed in a bony capsule. Body scaled. About 275 genera in the freshwaters of the world except South America, Australia and Madagascar (Nelson 1976). More species than any family of vertebrates (about 2,000 species). The first 2, 3 or 4 rays in the dorsal and the anal fins unbranched. Most anterior unbranched rays typically rudimentary.

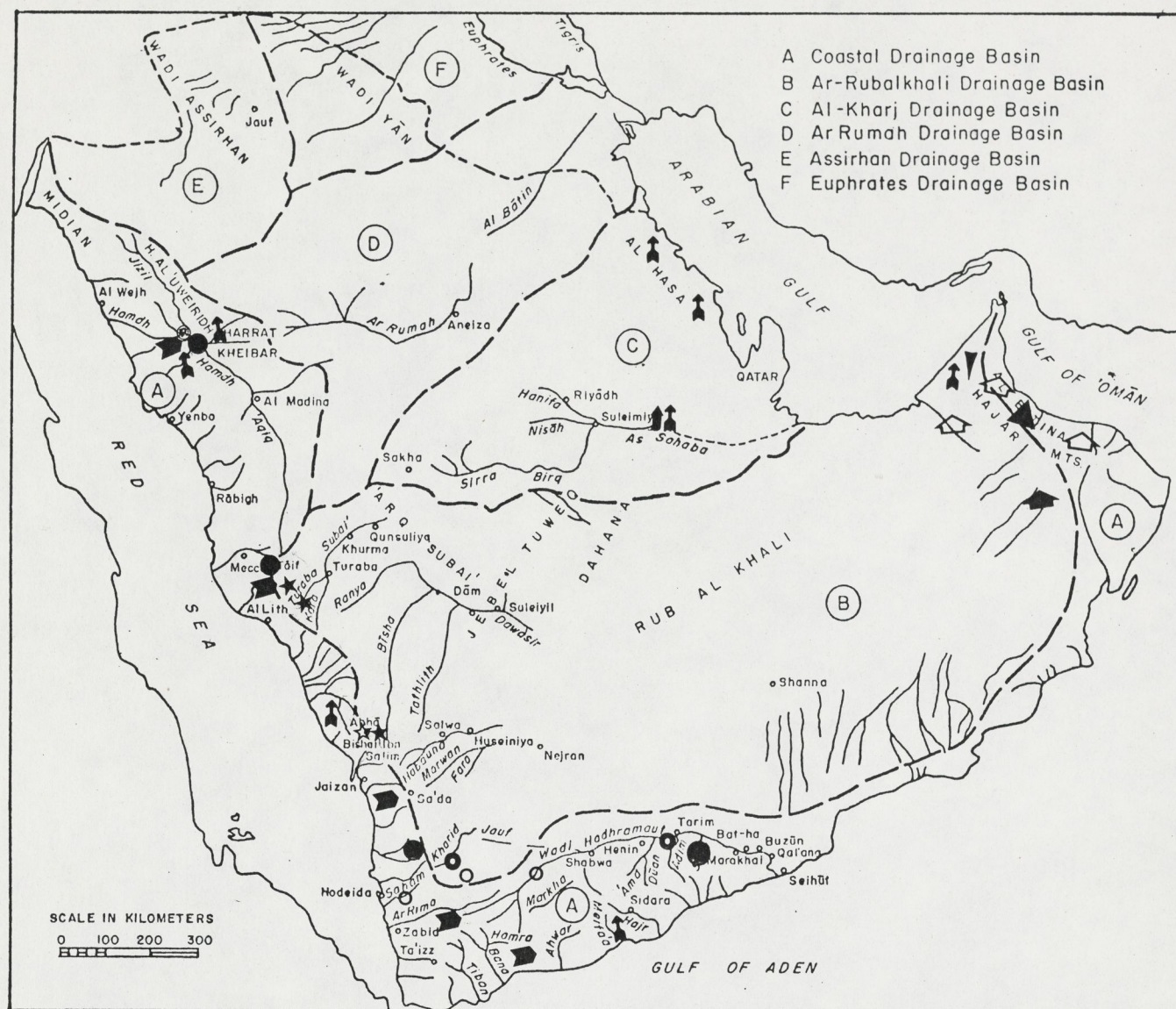


Figure 1. The distribution of Arabian freshwater fish.

B. apænsis (★), *B. exulatus* (●), *B. arabicus* (○),
C. watsoni (▲), *C. acinaces* (●), *C. mhalensis* (☆),
C. nemus (☆), *C. niger* (®), *G. tibanica* (▴),
G. barreimiae barreimiae (⬜), *G. b. shawkahensis* (▼),
G. longipinnis (▲), *Aphanius dispar* (♂), and
Gambusia affinis (♂).

No adipose fin. Mouth toothless, head scaleless. Mostly Cyprinidae are small and some are very strikingly colored.

Genus Barbus Cuvier, 1817

Barbus Cuvier, 1817, Regne, anim. II, p. 192 (type: B. barbus).

Typically with two pairs of barbels, seldom one or none. Mouth inferior, lips well developed. Pharyngeal teeth are 2.3.5-5.3.2 or 2.3.4-4.3.2. Peritoneum white or dark brown. Anal fin with 5 or 6 branched rays.

Taxonomic Outline

A most difficult and confusing problem of ichthyology is the classification of the African, Asiatic and European fish of the genus Barbus (Myers 1960). Barbus contain many phyletic lines of greater or lesser extent and the aggregate transcends the limit of what the majority of ichthyologists would consider a single genus (Myers op. cit.). Günther suggested it is necessary to subdivide several sections of the genus purely on geographical ground before he would handle the classification expeditiously (Myers op. cit.).

Boulenger divided Barbus into several sections, based on scale characters and it seems possible that these sections are of phylogenetic importance (Myers op. cit.).

The northeast African Barbus (large scale) and Barbus canis (Jordan River) are the logical ancestors to all known Arabian Barbus.

Distribution

Barbus is widespread in temperate or tropical parts of Europe, Asia, and Africa. The range of the genus in Arabia is the coastal drainages of the Red and Arabian seas. As far as known it is absent from the central drainages. There is no record of Barbus from Arabian Gulf drainages.

Several Barbus species occur in the Tigres-Euphrates basin, and B. barbatus is known from the Mond River drainage of Iran. No other gulf drainages were found to have Barbus (Saadati 1977). The number of Barbus species in Arabia is yet to be determined. Three species have been described. Barbus apoensis is known from Wadi Almhalen near Abha City, Wadi Turabah near Ataiif and Wadi Adamah, 19° 53' N, 41° 57' E. Barbus exulatus is known from several localities in the Wadi Hadhramaut and Wadi Maran in East Yeman. Barbus arabicus is widespread in the southwestern part of Arabia. This is of interest in speculation on derivation of gulf drainage species of Arabia (migrating across from Iran. In Iranian coastal drainages to Gulf (east of Tigres-Euphrates) Barbus and Varicorhinus (typical Tigres sp.) do not occur. Cyprinion and Garra are the common sp.

Wadi Mhala
* fig 1 shows
B. apoensis east
of coastal divide.
D.K.

Barbus apoensis Banister and Clarke, 1975

Barbus apoensis Banister, K. and M. A. Clarke. 1975. Jour. Oman Studies, Spec. Rep. (Sci. Results, Oman flora and fauna survey): p. 123.

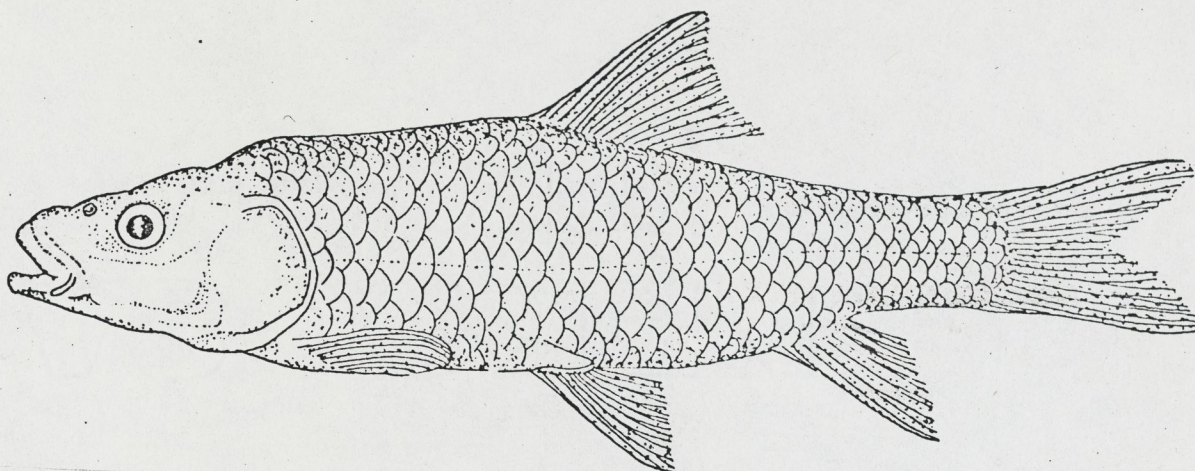


Figure 2. Barbus apoensis. 176 mm SL (adapted from Banister and Clarke. Freshwater Fishes of Arabian Peninsula. 1975.).

D IV 10, A III 6, L. L. 31

Specimen Examined

One specimen, 273 mm SL, was caught July 1977 from Wadi Almhaleh, a permanent stream between Khamis Mushyat and Abha City.

Description

The shape of the body can be seen in Figure 2. This species was described by Banister and Clark (1975) from a permanent stream near Khamis Mushyat and other localities in Saudi Arabia. They based their description on 12 specimens. According to their description,

"the greatest depth of the body occurs about halfway between the origin of the pectoral fin and the origin of the dorsal fin. A pronounced nuchal hump is present and the dorsal profile of the head is concave. The mouth is terminal and has marked upwardly directed gape. The anterior barbels are absent and the posterior barbels are small. The eyes are lateral and slightly protuberant. The lips are continuous. There are 4 unbranched rays in the dorsal fin. The last one is thickened into an unserrated, smooth spine. The spine is not strongly ossified and is flexible in its distal third. There are 10 branched dorsal rays. The lateral line scales

*22 through 700
2000
415 specimens*

number 26-29. Twelve scales encircle the least circumference of the caudal peduncle. There are 2.3.5-5.3.2 pharyngeal teeth. The gill rakers are strong, curved and widely spaced. They decrease rapidly in size from the angle of the gill arch forwards. On the lower limb of the first gill arch there are 6-9 gill rakers."

The specimen examined from Wadi Almhaleh shows the characters described above except for some differences noted such as 31 scales in the lateral line instead of 26-29. Ten scales encircle the least circumference of the caudal peduncle. A well-developed bony ridge is present from the occiput to dorsal fin origin. The lateral line is straight. Other morphometric data are presented in Table 1.

Table 1. Morphometric characters of Barbus apoensis from Wadi Almhaleh.

		% of standard length
TL	324 mm	-
SL	274 mm	-
BD	84 mm	0.31
HL	88 mm	0.32
OL	14 mm	0.05
UJL	26 mm	0.09
DO	149 mm	0.55
DFBL	42 mm	0.02
DFDL	65 mm	0.22
BL	10 mm	0.04
CPD	30 mm	0.11
CPL	45 mm	0.16

Abbreviations: TL=total length; SL=standard length; BD=body depth; HL=head length; OL=orbit length; UJL=upper jaw length, measured from barbel to short-tip; DO=dorsal origin to short-tip; DFBL=dorsal fin based length; DFDL=dorsal fin depressed length; CPD=caudal peduncle least depth; CPL=caudal peduncle length; IL=intestine length; AFDL=anal fin depressed length; BL=barbel length; D=number of dorsal fin rays (Roman numeral for unbranched rays, arabic numeral for branched rays); A=anal fin rays; P=pectoral fin rays; V=ventral or pelvic fin rays; L.L=scales count in lateral line.

Coloration

Live colors are golden with olive fins. Preserved specimen is pale-yellow below and gray-brown above.

Distribution

This species is known from Wadi Almhaleh between Khamis Mushyat and Abha. According to our knowledge of the area the type locality is the same as mentioned by Banister and Clark (1975). Other than Wadi Almhaleh, the species is known from Wadi Turabah, near Ataif and Wadi Adamah, Saudi Arabia (Figure 1).

Relationships

The only other known species of Barbus typically with 6 branched anal fin rays are Barbus exulatus (endemic to Arabia) and Barbus canis (endemic to Jordan River). Barbus exulatus resembles B. apoensis by having 6 branched anal fin rays, but it has two pairs of barbels, whereas B. apoensis has only one pair. The other known Arabian species, Barbus arabicus, and all large Barbus species of northeast Africa have 5 branched anal fin rays (Banister and Clark 1975).

"Barbus canis resembles B. apoensis in general appearance and more importantly in the possession of 6 branched rays in the anal fin" (Banister and Clark 1975). We are in agreement with Banister and Clarke that this character may serve to define a lineage within the Barbus species indigenous to Arabia and the Jordan River basin.

Barbus apoensis can be distinguished from Barbus canis by having fewer scales in the lateral line (26-30 vs. 30-40), one pair of barbels, and the dorsal profile of the head is more concave. Barbus exulatus is superficially like B. canis, but differs in several respects, such as: a sheath of enlarged scales at the base of the anal fin, subterminal mouth (terminal in B. canis), and a much longer, stronger dorsal spine (Banister and Clarke 1975). Banister and Clarke (1975) suggested that Barbus exulatus and Barbus apoensis are a sister group to Barbus canis.

Barbus exulatus Banister and Clarke, 1975

B. exulatus^B banister, K. and M. A. Clarke. 1975. Jour. Oman Studies, Spec. Rep. (Sci. Results, Oman flora and fauna survey): p. 123.

Banister and Clarke (1975) described this species from several localities associated with the Wadi Hadhramaut and Wadi Maran, East Yeman. According to their description the body of this species is slightly compressed and the dorsal profile is arched. Two pairs of barbels are present. There are 4 unbranched and 7-9 branched dorsal rays. There are 3 unbranched and 6 branched anal rays. The lateral line scales count ranges from 24-28. Gill rakers are short and widely spaced. Their count on the lower limb of the first gill arch ranges from 6-9.

Banister and Clarke (1975) suspected that Barbus exulatus and Barbus apoensis form a sister group to Barbus canis based on the 6 branched rays in the anal fin.

Barbus arabicus Trewavas, 1941

Description

There are no specimens in our collection, so only the briefest description will be given here (see Banister and Clark 1975 for more detail).

The morphometric and meristic data for the holotype are: SL = 346 mm; DB = 20.0; HL = 131.2; CPL = 14.9; CPD = 8.4; L.L. 28; The horizontal eye diameter = 3.3; the least bony interorbital width = 9.6; the width of the widest part of the mouth = 9.0; the greatest length of the pectoral fin = 19.8; the number of scales around the least circumference of the caudal peduncle = 12; and the length of the anterior barbel = 7.2. In non-typical specimens (26-203 mm SL) the body is slim and graceful. The head is longer, the body is deep, the snout is acutely or obtusely pointed in lateral view. The mouth is subterminal. There are two pairs of long barbels. The eye is small and supero-lateral in position.

The origin of the dorsal fin is in the posterior half of the body. There are four unbranched rays, the last of which is ossified into a smooth straight spine. Only a very small part of the tip of the spine is flexible. There are 7-9 branched rays. The dorsal margin of the fin is concave when the fin is erect.

The anal fin has three unbranched rays and five branched rays.

There are 25 to 32 scales. All specimens show some degree of reduction in the number and size of scales on the breast and in some specimens the breast is apparently scaleless.

There are 12 scales around the least circumference of the caudal peduncle. The pharyngeal teeth are numbered 2.3.5-5.3.2. The gill rakers number 9-13 on the lower limb of the first gill arch. The gill rakers are moderately slender, short and curved towards the mid-line (Banister and Clark 1975).

Distribution

This species seems to be widespread in the southwestern part of the Arabian Peninsula. It has been recorded from Wadi Maur, near Al-Zorah, northern Tihamah in Saudi Arabia (Figure 1).

Relationships

"Barbus arabicus can be easily distinguished from all other Arabian Barbus species because it has only five branched rays in the anal fin" (Banister and Clark 1975). Trewavas (1941) considered this species to be more closely related to some Indian species and to Barbus canis than to any of the African Barbus. However, Barbus canis has 6 branched rays in the anal fin, an important difference between B. arabicus and B. canis. Banister and Clarke (1975) aligned Barbus arabicus with the species of Barbus in northeastern Africa--the Barbus intermedius complex because of the following reasons: The morphological similarity between these two species, i.e. the possession of the same type of scale striation (more or less parallel), a caudal peduncle longer than deep, and a well ossified straight dorsal spine (Banister and Clark 1975). The phenotypic variability of Barbus arabicus parallels Barbus intermedius (Banister 1974). The distribution of Barbus arabicus, i.e. in the southern part of Arabia just across the Red Sea from Barbus intermedius, suggests an African origin (Banister and Clarke 1975).

Genus Cyprinion Heckel

Cyprinion Heckel, 1843, ^{3 sp.} Russger Reisen, 1, p. 1015 (type: C. macrostomus).

Fishes of moderate size; scales of moderate size; dorsal fin with an osseous and serrated spine and numerous branched rays; mouth inferior; pharyngeal teeth 2.3.4-4.3.2; one pair of barbels; peritoneum black; alimentary canal long and convoluted; air bladder bipartite or tripartite; seven branched anal rays.

A new generic character discovered by Saadati (1977) is a dorsal ridge derived from fused interneural bones.

Distribution

This genus is widespread in west Pakistan, Afghanistan, Arabia, Iran, Iraq and Syria. It occurs in all drainages to the Indian Ocean, and in tributaries to the Arabian Gulf.

In Arabia based on Banister and Clarke's studies (1975) Cyprinion occurs in the coastal drainages and Ar-Rub'alkhali Basin.

In Saudi Arabia, based on our collections, the genus occurs in the Wadi Almhaleh (Ar-Rub'alkhali Basin) and the Red Sea drainages. Our collections consist of 57 specimens of Cyprinion from different springs and streams in Khaybar, N. Al-Hijaz and Wadi Almhaleh near Abha City. Cyprinion acinaces and Cyprinion niger were collected from Khaybar springs. C. mhalensis and C. nemus were collected from Wadi Almhaleh in the Asir highlands. C. mhalensis, C. nemus, and C. niger are well differentiated from any described species by a long intestine (5.5 times the total body length), number of scales (29 or 42) and other morphological characters which are discussed below.

Taxonomic Outline

The systematic status of the species of Cyprinion is still not well delineated. The problem is that there appears to be no clear cut difference between species with 10 branched dorsal rays. Until 1949 about fifteen species of Cyprinion were commonly recognized (Saadati 1977). Berg (1949) revised the genus and recognized only six species. The species recognized by Berg are: C. microphthalmum, C. macrostomum (Tigres-Euphrates Basin), C. irregulare, C. watsoni, C. milesi (Indian Ocean and Gulf drainages) and C. tenuiradius.

Mirza (1969) synonymized Cyprinion irregulare with Cyprinion watsoni. He recognized three species in Pakistan, C. watsoni distinguished by having an arched mouth, a conspicuous scaleless ridge on the back, bipartite air bladder, and the length of the alimentary canal about three times the total body length. C. milesi was distinguished by having a longer head and oblique mouth. C. microphthalmum was distinguished by having a transverse mouth, tripartite air bladder and the length of the alimentary canal more than 3.5 times the total body length.

Saadati (1977) indicated that the condition of the dorsal spine is highly variable in Iranian Cyprinion. Stout, weak and intermediate spines were found in a single sample.

Prior to the publication of Banister and Clarke's work (1975), only Cyprinion microphthalmum was known from Arabia. Banister and Clarke (1975) described Cyprinion acinaces as a new species from Arabia. Our collections contain four species of Cyprinion. One of these, Cyprinion acinaces, was described by Banister and Clarke (1975). Three species are new.

The occurrence of Cyprinion microphthalmum in Arabia is questionable. The species described in Oman as Scaphiodon muscatensis by Boulenger (1887) and considered as C. microphthalmum by Berg (1949) is more likely Cyprinion watsoni.

Cyprinion acinaces and the three new species most probably diverged from an ancestral species invading Arabia during the Pliocene.

Cyprinion acinaces Banister and Clarke, 1975

Cyprinion acinaces Banister, K. and M. Clarke. 1975. Jour. Oman Studies, Spec. Rep. (Sci. Results. Oman flora and fauna survey): p. 123.

Material Examined

20 specimens were collected July 1977 from Ain Al-Bhair, Khaybar, N. Al-Hijaz.

14 specimens were collected July 1977 from Ain Slaliem, Khaybar, N. Al-Hijaz.

12 specimens were collected July 1977 from Ain Ali (Abowashia), Khaybar, N. A.-Hijaz.

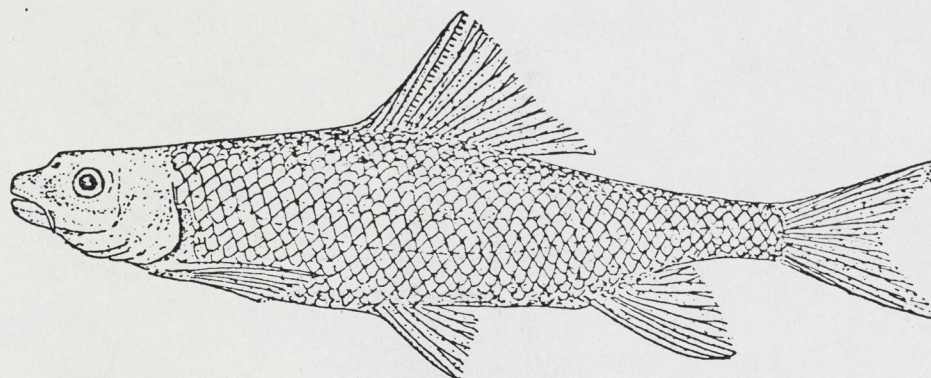


Figure 3. Cyprinion acinaces. 29-110 mm SL.

D IV 12 (11), A III 7, V q, L.L. 32-38.

Description

The shape of the body can be seen in Figure 3. According to Banister and Clarke's (1975) description,

"the mouth is ventral. The anterior edge of the lower jaw is gently curved and covered with a sharp-edged horny sheath. Barbels are short. Tubercles are present on the snout and interorbital region of some specimens. The eyes are lateral and visible in ventral view. The peritoneum is black. The skin between the pelvic fin base is fatty, thickened and papillose. The development of the thickened skin varies considerably. It is a heart-shaped patch of skin, although the papillae are continued onto the pelvic fin rays. At the other extreme there are three flaps: there is a median, posteriorly directed flap laying between the pelvic fin bases flanked on each side by a smaller flap which may cover the bases of the pelvic fins. The dorsal fin has four unbranched rays and 11-12 branched rays. The last unbranched ray is ossified into a long straight spine with a strongly serrated posterior face. The anal fin has three unbranched rays and seven branched rays.

In the lateral line there are 34-39 scales. Pharyngeal teeth number 2.3.4-4.3.2. Gill rakers are widely spaced, short, thin and slightly curved. On the lower limb of the first gill arch there are 8-12 gill rakers."

Specimens of this species possess well developed bony ridge without scales between the occiput and the origin of the dorsal fin similar to that seen in Cyprinion watsoni. The head is elongated. Mouth is of variable shape, i.e., ventral, transverse, oblique, terminal or subterminal. In ~~other~~^{some} specimens the mouth contains a sharp curved blade in the lower jaw, while in ~~yet~~ others the cornified blade is weakly developed. The lateral line is straight in some specimens, curved in others. Lateral line scale counts range from 32 to 38.

There are 2-4 scales between ^{the} lateral line and the pelvic fin. There are 15-16 scales around the least circumference of the caudal peduncle. There are 5-8 scales above the lateral line. In some specimens there are no fatty-thickened papillose skin between the bases of the pelvic fin, but other specimens do have this structure. Brown spots above the lateral line present in young disappear in adults. There are tubercles in some male specimens. The stomach is well developed. The intestine length is from 2.1 to 3.6 times of the total length. The gas bladder has two chambers. Its posterior chamber is longer and slightly narrower than the anterior one. There are nine rays in the pelvic fin. The pectoral fin has 16 rays. Pectoral fins do not reach pelvic fins. Gill rakers on the first gill arch are short, strong and curved, their count ranges from 12-15. There are 20-25 gill rakers on the posterior side of the first gill arch. There are 23-28 gill rakers on the anterior side of the second gill arch. The caudal peduncle is narrow and short. The caudal fin is forked. The anus is immediately in front of the anal fin. Morphometric characters are presented in Table 2.

Coloration

Fresh specimens are gray dorsally, silver laterally, and silver ventrally. Preserved specimens are gray-brown dorsally, silver-gray or white-gray laterally. Dark brown spots are present above the lateral line in young specimens. These spots become obscure in older specimens.

Distribution

Previously this species was known only from Wadi Hadhramaut and in a stream at (or near) Taif (Saudi Arabia). Our collections extend the range to Kheibar springs in Saudi Arabia (Figure 1).

Relationships

The only Cyprinion with a strongly serrated dorsal spine is Cyprinion macrostomum but Cyprinion acinaces can be distinguished by having fewer branched rays in the dorsal fin (11-12 vs. 13-15, mostly 14), fewer branched rays in the anal fin (7 vs. 8), fewer scales (32-38 vs. 38-43). Banister and Clarke (1975) were unsure of the affinities of C. acinaces. In our opinion the presence of the conspicuous scaleless dorsal ridge and general agreement in other characters suggest the closest relationships of Cyprinion acinaces to Cyprinion watsoni - microphthalmum group.

Table 2. The morphometric characters of Cyprinion acinaces.

	n	\bar{X}	Percent of Standard Length	S.D.	Range
TL	46	100.7	----	20.4	65-136 mm
SL	46	78.8	----	17.0	50-117 mm
BD	46	23.2	0.29 ^a	6.2	13-36 mm
HL	46	22.5	0.28	4.6	15-30 mm
OL	46	5.8	0.07	0.8	4-8 mm
UJL	46	5.9	0.07	1.1	4-8 mm
DO	46	40.3	0.51	7.7	30-55 mm
DFBL	46	18.1	0.23	3.9	12-27 mm
DFDL	46	25.1	0.32	5.4	16-36 mm
BL	44	3.7	0.05	0.8	5-3 mm
CPD	46	8.3	0.11	2.0	5-14 mm
CPL	46	13.4	0.17	2.9	8-19 mm
IL	11	254.3	3.20	59.6	170-350 mm
AFDL	46	15.2	0.19	3.7	10-26 mm

Abbreviations as in Table 1.

Cyprinion mhalensis, new species

D-IV-III 10, A III-7, L. L. 40-43.

Material Examined

Holotype, no. 1 in collection of Arabian fishes, Department of Fishery and Wildlife Biology, Colorado State University, standard length, 141 mm, collected July 1977 from Wadi (Valley) Almhaleh near Abha City (permanent stream). Paratypes (no. 2), seven specimens collected from the same locality

Description

The shape of the body can be seen in Figure 4(a). The mouth is transverse, subterminal, oblique or ventral. The anterior edge of the lower jaw is curved, covered with a well developed blade. The blade in some specimens is not well developed, especially in small fish. The snout is blunt and short. The interorbital space is flat. There is one small pair of barbels. Tubercles are absent on the snout and interorbital region of the specimens examined. There is a well developed bony ridge from the occiput to dorsal fin. The degree of the development of the bony

* must
move
decimals
2 places
to
p. 10

ridge is more conspicuous in large specimens. Peritoneum is sooty black. No scales on ventral side. The eyes are lateral and visible in ventral view. The standard length is 3.8 times longer than the body depth. The head length is 3.7 times longer than the orbit. The standard length is 3.8 times longer than the head. The caudal peduncle is long and narrow; the caudal fin is forked. The caudal peduncle length is 18% of the standard length. The caudal peduncle depth is 10% of the standard length. The stomach is well developed and muscular. The intestine is very long in one specimen; its length from the end of the stomach is 5.5 times the total length, while in other specimens this length is about 4.0 times the total length. The air bladder is bipartite, its posterior chamber is longer and slightly more narrow than the anterior one.

N=2
or
N=8
- ranges from
4.0 - 5.5 in
8 specimens

There are 3 or 4 unbranched rays and 10 branched rays in the dorsal fin (last two counted as one). Last unbranched ray is ossified almost to the tip and strongly serrated all along ossified segments. The dorsal fin origin is opposite of the origin of ventral fin. The dorsal spine length is shorter than the body depth.

There are 3 or 4 unbranched anal fin rays and 7 branched rays. The anal fin when laid flat does not reach the caudal fin. The anus is immediately in front of the anal fin.

Squamation. There are 40-43 (41.4) scales in the lateral line. The lateral line is normally straight to the middle of the caudal peduncle, but in some specimens it is slightly curved. No scales on the bony ridge.

Gill Rakers. Gill rakers are short, slightly curved and thin. On the anterior side of the first gill arch there are 11-16 (13.1) gill rakers. On the posterior side of the first gill arch there are 21-32 (24.4) gill rakers. On the anterior side of the second gill arch there are 22-31 (26) gill rakers. Morphometric data are given in Table 3.

Coloration

Preserved specimens in alcohol are gray-brown dorsally and silver-gray below the lateral line. Dark brown patches are present above the lateral line in some specimens especially young fish. These patches disappear in mature fishes.

Distribution

This species was collected only from Wadi Almhaleh, a permanent stream near Abha City (Fig. 1). *Sympatric w/ C. nemus*

Etymology

The specific name is named for type locality, Wadi Almhaleh.

Relationships

Cyprinion mhalensis does not resemble other Arabian Cyprinion species. It differs in certain characters such as long intestine (4-5.5 times the

we'll modify this section to allow for possible future classification as subsp. of acincus - but wait for 1981 collections.



Figure 4. Three new species of Cyprinion:
A. Cyprinion mhalensis (141 mm SL)
B. Cyprinion niger (124 mm SL)
C. Cyprinion nemus (81 mm SL)

total length) and general morphology. This species can be distinguished from C. acinaces in general appearance, fewer branched rays in the dorsal fin (10 vs. 12), more scales in the lateral line (40-43 vs. 32-28), and more gill rakers on the anterior side of the first gill arch (11-16 vs. 12-14). The affinities of this species are uncertain. Although all Arabian Cyprinion are most likely derived from an ancestor of Cyprinion watsoni and the scaleless bony ridge indicates such affinities, under the present state of knowledge of the genus it would be premature to state opinions with more authority.

(38)
to acinaces

Table 3. Morphometric characters of Cyprinion mhalensis.

	n	\bar{x}	Percent of Standard Length	S, D.	Range
TL	8	110.5	----	37.3	72-180 mm
SL	8	85.5	----	29.8	55-141 mm
BD	8	22.4	0.26	7.7	15-37 mm
HL	8	22.8	0.27	7.1	15-34 mm
OL	8	6.1	0.07	0.8	5-7 mm
UJL	8	6.3	0.07	1.8	5-9 mm
DO	8	44.5	0.52	15.2	30-73 mm
DFBL	8	17.0	0.20	6.0	11-27 mm
DFDL	8	22.1	0.26	7.5	16-37 mm
BL	8	3.3	0.04	0.9	2-5 mm
CPD	8	8.6	0.10	2.6	6-14 mm
CPL	8	15.3	0.18	5.6	9-23 mm
IL	8	407.9	4.80	291.4	125-986 mm
AFDL	8	18.8	0.22	8.8	9-35 mm

Abbreviations as in Table 1.

Cyprinion nemus, new species

D IV 10, A III 7, L. L. 29-30.

Material Examined

Holotype, no. 3 in Arabian fish collection, Colorado State University, standard length 81 mm, collected July 1977 from Wadi Almhaleh, a permanent stream near Abha City. Paratype, no. 3A. One specimen, standard length 78 mm, collected from same locality.

Description

The shape of the body can be seen in Figure 4 (c). The head is short and obtuse. Mouth is terminal. Anterior edge of the lower jaw is curved and is not covered with well developed blade. There is one small pair of barbels. The length of the barbel is less than the diameter of the eye (3-4 mm vs. 6-7 mm). No tubercles. There is a weakly developed bony ridge from the occiput to the dorsal fin origin. Peritoneum is sooty black. There are no scales on the ventral side of one specimen, but the other specimen does have ventral scales. The standard length is 3.7 times longer than the body depth. The standard length is 3.1 times longer than the head. The head length is 4.24 times longer than the orbit. The head length is 3.25 times longer than the upper jaw. Caudal peduncle is long and narrow. The caudal fin is forked. The caudal peduncle length is 19% of the standard length. The caudal peduncle depth is 12% of the standard length. The stomach is muscular. The intestine length is 3.0 times the total length. The air bladder is bipartite, the posterior chamber is longer and slightly narrower than the anterior one.

There are 4 unbranched rays and 10 branched rays in the dorsal fin. The last unbranched ray is ossified and has no serration. The dorsal fin origin is opposite the origin of the ventral fin.

There are 3 unbranched rays and 7 branched rays in the anal fin. The anus is immediately in front of the anal fin.

Squamation. The lateral line is straight or curved to the middle of the caudal peduncle. There are 29-30 (29.5) scales in the lateral line in the two specimens.

Gill rakers. Gill rakers are short, slightly curved and thin. There are 9-11 (10) gill rakers on the anterior side of the first gill arch. There are 14-16 (15) gill rakers on the posterior side of the first gill arch. On the anterior side of the second gill arch there are 14-16 gill rakers.

Morphometric characters are presented in Table 4.

Coloration

Alcohol preserved specimens are brownish dorsally and yellow-brown below the lateral line. No spots on the middle of the flank.

Distribution

This species was collected from the same locality (Wadi Almaleh) as C. mhalensis (Figure 1).

Etymology

The specific name is derived from the Latin word for pasture and describes the pastoral setting of locality.

Relationships

Cyprinion nemus differs from all known Cyprinion species by unserrated dorsal spine. It differs by fewer scales (29-30) from all known Cyprinion species except an undescribed species mentioned by Saadati (1977) from Iran with 26-27 scales.

From C. mhlansis, C. nemus differs in general morphology, fewer scales (29-30 vs. 40-43) and fewer gill rakers (9-11 vs. 11-16) on the anterior side of the first gill arch, and unserrated dorsal spine.

From C. acinaces, C. nemus differs in general morphology, fewer branched rays in the dorsal fin (10 vs. 12), fewer scales in the lateral line (29-30 vs. 32-38) and fewer gill rakers on the anterior side of the first gill arch (9-11 vs. 12-16) and unserrated dorsal spine. The affinities of this species are uncertain. It likely represents a "sister" species of C. mhalensis diverging from a common ancestor in Arabia.

Table 4. Morphometric characters of Cyprinion nemus.

	n	\bar{X}	Percent of Standard Length	S.D.	Range
TL	2	104	----	----	-104 mm
SL	2	79.5	----	2.1	78-81 mm
BD	2	21.5	0.27	0.7	21-22 mm
HL	2	25.5	0.32	0.71	25-26 mm
OL	2	6.0	0.08	----	-6 mm
UJL	2	8.0	0.10	----	8 mm
DO	2	43.0	0.54	2.8	41-43 mm
DFBL	2	16.0	0.20	1.4	15-17 mm
DFDL	2	22.5	0.28	3.3	20-25 mm
BL	2	3.0	0.05	----	-4 mm
CPD	2	10.0	0.13	----	-10 mm
CPL	2	15.0	0.19	2.8	13-17 mm
IL	2	140.0	1.76	28.3	120-160 mm
AFDL	2	13.5	0.17	2.1	12-15 mm

Abbreviations as in Table 1.

Cyprinion niger, new species

D IV 10, A III 7, L. L. 40

Material examined

One specimen, no. 10, Arabian fish collection, Colorado State University, standard length 124 mm, was collected July 1977 from Ain Ali (a spring), Kheibar City, N. Al-Hijaz.

Description

The shape of the body can be seen in Figure 4 (b). The snout is short and blunt. The mouth is transverse with a weakly developed blade. The interorbital space is flat. There is one small pair of barbels. The barbel length is smaller than the orbit length. No tubercles on the snout and the interorbital region of the specimen examined. There is a well developed bony ridge from the occiput to the origin of the dorsal fin. The peritoneum is sooty black. No scales are on the ventral side. The standard length is 3.9 times longer than the body depth. The standard length is 3.8 times longer than the orbit. The standard length is 14.4 times longer than the head. The caudal peduncle is very narrow and long. The caudal fin is deeply forked. The caudal peduncle length is 19% of the standard length. The caudal peduncle depth is 6% of the standard length. The stomach is well developed and muscular. The intestine length is 2.1 times the total length. The air bladder is bipartite, its posterior chamber is longer and slightly narrower than the anterior one.

There are 4 unbranched rays and 10 branched rays in the dorsal fin. The last unbranched ray is strongly ossified almost to the tip and serrated. Its length is shorter than the body depth (22 vs. 25). The dorsal fin origin is opposite to the origin of the ventral fin.

There are 3 unbranched rays and 7 branched rays in the anal fin. The anal fin when laid flat does not reach the caudal. The anus is directly in front of the anal fin.

Squamation. The lateral line is straight to the middle of the caudal peduncle. There are 40 scales in the lateral line. There are 6 scales above the lateral line.

Gill rakers. Gill rakers are curved, short and thin. On the anterior side of the first gill arch there are 14 gill rakers, and on the posterior side of the first gill arch there are 24 gill rakers. On the anterior side of the second gill arch there are 28 gill rakers.

Measurements data are presented in Table 5.

Coloration

Alcohol preserved specimen is dark-brown dorsally and silver-gray below the lateral line. No dark spots on the middle of the flank.

Distribution

This species was only collected from Ain Ali (Ali's spring), Kheibar City, N. Al-Hijaz (Figure 1.)

sympatric w/ C. acinacer

Table 5. Measurements in millimeters of Cyprinion niger.

		% of standard length
TL	158 mm	-
SL	124 mm	-
BD	25 mm	0.20
HL	30 mm	0.24
GL	8 mm	0.10
UJL	8 mm	0.10
DO	65 mm	0.52
DFBL	25 mm	0.20
DFDL	36 mm	0.29
BL	3 mm	0.02
CPD	8 mm	0.06
CPL	24 mm	0.19
IL	330 mm	2.60
AFDL	26 mm	0.21

Abbreviations as in Table 1.

Etymology

The specific name is derived from the Latin word for black, denoting the black rocks of the habitat of the type locality.

Relationship

Cyprinion niger does not closely resemble other Arabian Cyprinion species except some similarities with the C. mhalensis. This species can be distinguished from C. acinaces in general morphology, fewer branched rays in the dorsal fin (10 vs. 12) and more scales in the lateral line (40 vs. 32-38). C. niger differs from C. nemus by the shape and the color of the body, more scales in the lateral line (40 vs. 29-30) and more importantly by having a strong serrated spine in the dorsal fin.

C. niger probably is most closely related to C. mhalensis and C. nemus forming an endemic western Arabia species group of Cyprinion. The major distinction between C. niger and C. mhalensis is the greater relative length of the intestine in C. mhalensis (4.0-5.5 vs. 2.1) and the longer, more narrow caudal peduncle in C. niger. The diagnosis of C. niger is based on a single specimen and more specimens will be necessary to determine the range of variation in its diagnostic characters. The possession of bony ridge, 10-12 dorsal rays and bipartite air bladder indicates all Cyprinion species were derived from a common ancestor with

C. watsoni probably during Pliocene times. C. watsoni in Oman is probably derived from a late Pleistocene crossing of a fresh-water Gulf. There are no Cyprinion in Africa, thus we assume the ancestors of the endemic species migrated to the West Coast of Arabia after freshwater connections to Africa had been lost. An alternative hypothesis is that freshwater connections to Africa may have been present when the Cyprinion ancestors arrived in western Arabia (when Garra migrated to Africa from Arabia and Barbus migrated from Africa to Arabia), but they were blocked from establishing representative populations in Africa because of competitive exclusion from Barbus.

Cyprinion watsoni (Day) or microphthalmum

Schaphiodon watsoni Day, 1872, Jour. Asiat. Soc., Bengal, XLI, pt. II, p. 324 (India).

Saadati (1977) gave the characters of 48 specimens from Iranian Gulf drainage and other localities (Bampur, Lut and Mashkel basins). According to Saadati's description the dorsal fin has 4 unbranched and 9-11 (mostly 10) branched rays. There are 3 unbranched and 7 branched anal rays. The lateral line scales number range 34 to 42. There are 8-14 gill rakers on the anterior side of the first gill arch. The mouth shape is variable from transverse to the arch shape. Mirza (1969) mentioned that this species has bipartite air bladder and its intestine length is about 3 times the total length.

The species described in Oman as Scaphiodon muscatensis by Boulenger (1887) and considered as C. microphthalmum by Berg (1949) is more likely Cyprinion watsoni based on the presence of C. watsoni in all Iranian drainages to the gulf. All Arabian Cyprinion appear to represent divergences in the Cyprinion watsoni species group. The species endemic to Arabia pliocene invasion and C. watsoni in Oman is probably derived from a late pleistocene crossing of the Gulf when lowered ocean levels created a freshwater environment in the Gulf as mentioned by Banister and Clarke (1975).

Genus Garra Hamilton

Garra Hamilton, 1822, Fishes of the Ganges, Edinburg, pp. 343 (type: Cyprinus lamta).

Mouth transverse. Lips continuous covered with anterior and posterior labial folds. Jaws covered with horny sharp edge. Snout more or less rounded or slightly conical. Barbels generally four, sometimes two or more. Pharyngeal teeth edentulous in three closely approximating rows: The inner 5 or 4, the middle 4 or 3, the outer 3 or 2. The typical number is 2.4.5-5.4.2. Scales of moderate size. Dorsal fin with 9 to 12 rays, 6 to 9 of which branched (II, 6 - III, 9) originating in advance of pelvics. Anal fin short with 6 to 8 rays (I, 5 - III, 5), Pectoral I - II, 17.

Lower lip modified into a suctorial disk with free anterior and posterior margins. Gill rakers widely set, short and few. Air bladder varies in form and extent. (Menon 1964).

Distribution

The genus Garra is widespread from South China and Borneo in the east, through Burma, India and Ceylon, Afghanistan, Iran, Syria and Arabia to Somaliland, Ethiopia, East Africa and then southward to Guinea through the Congo (Menon 1964).

In Arabia species of this genus are recorded from Oman, United Arab Emirates (Gulf of Oman and Arabian Gulf drainages), Saudi Arabia and Yemen. Specimens of Garra were collected from Wadi Almhaleh near Abha City and one spring at Kheibar City, North Al-Hijaz.

Taxonomic Outline

The genus Garra was described by Hamilton in 1822 based on Cyprinus lamta. Heckel described several species under a new genus Discognathus from Iraq, Syria, and Iran. Heckel described Discognathus fusiformes from Bombay, and in 1846 recorded the occurrence of Discognathus in Ethiopia. Günther listed D. lamta, D. macrochir, D. variabilis and D. nasutus in his "Catalogue of Fishes in the British Museum" (Menon 1964). Günther, Playfair and Blanford referred to D. lamta specimens from Afghanistan, Arabia, Ethiopia, respectively (Menon 1964).

Berg (1949) revised this group and divided it into two genera, Garra (two pairs of barbels) and Discognathus (one pair of barbels). Berg also pointed out that the sucking disc in Discognathus is fused at the anterior margin, whereas it is free in Garra. Berg recognized two species of Discognathus: D. variabilis and D. rossica. Menon (1964) included Discognathus as a species group of Garra. Menon's arrangement of Garra is as follows:

- a) The variabilis group (= Discognathus)
Garra variabilis (Heckel) and G. rossica (Nikolsky) are the only species in this group. Saadati (1977) found an undescribed species in Iran.
- b) Gotyla group.
- c) Tibanica group. This group involved seven complexes and 28 species.

According to Menon (1964) the Garra species of Arabia, Iraq, Iran and Syria belong to the "rufa" complex of the tibanica group which consists of G. rufa rufa (Heckel) from Syria and Palestine, G. rufa obtusa (Heckel) from Iraq and Iran and G. barreimiae (Fowler and Steinitz) from Arabia (Saadati 1977).

Banister and Clarke (1974) recognized three species of Garra in Arabia:

- 1) Garra barreimiae Fowler and Steinitz, 1956.

2) Garra longipinnis Banister and Clarke, 1975.

3) Garra tibanica Trewavas, 1941.

They recognized two subspecies of G. barreimiae, Garra barreimiae barreimiae and Garra barreimiae shawkahensis. They agreed with Menon (1964) in aligning G. barreimiae with G. rufa, which is widely spread between the Mediterranean and the Tigris-Euphrates System. They related G. longipinnis with G. barreimiae.

Our collections from western Saudi Arabia contain only Garra tibanica from Wadi Almhaleh, near Abha City, and from one spring in Kheibar City.

Garra tibanica Trewavas, 1941

Discognathus lamta: Playfair, 1870, proc. zool. soc.:85 (not Hamilton, 1822).

Garra tibanica Trewavas, 1941, British Museum (natural history) Expedition to southwest Arabia 1937-8, I(3):8.

Garra brittonia Trewavas, 1941, British Museum (natural history) Expedition to southwest Arabia 1937-8, I(3):11.

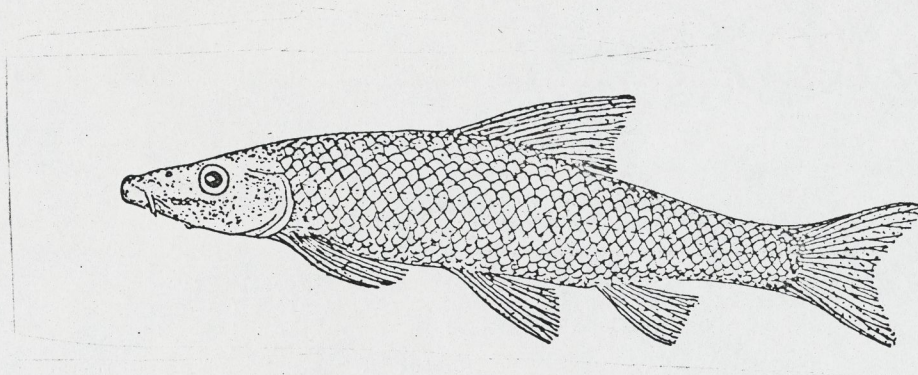


Figure 5. Garra tibanica. 78 mm SL

D III 7, A III 5, L. L. 30-36, P. 14-16, v. 8-9.

Materials Examined

- a. Two specimens, 73-86 mm SL from Wadi Almhaleh (permanent stream) between Khamis Mushyat and Abha City, were caught in 1977.

b. Two fish, 38-46 mm SL from a spring in Kheibar, North Al-Hijaz.

In 1975 Banister and Clarke described this species from different localities in Arabia (Figure 5). They based their description on 93 specimens, 46-110 mm SL. According to their description,

The snout is blunt and distinctly wedge-shaped in dorsal views pointed inside view. Most specimens possess horny tubercles on the sides and top of the snout. The mental disc is variable in shape. The anus is immediately in front of the anal fin. The dorsal fin has three or four unbranched rays; the last unbranched ray is not ossified. There are six, seven, or eight branched rays. The anal fin has three unbranched rays and five branched rays. The lateral line has 30-36 scales. Around the least circumference of the caudal peduncle there are 12 to 20 scales. The pharyngeal teeth number 2.4.5-5.4.2 in all specimens examined. The gill rakers are short and widely spaced. On the lower limb of the first gill arch there are 6-17 gill rakers.

The four specimens collected in 1977 are similar to the description given by Banister and Clarke. According to our specimens the lateral line is straight, the caudal peduncle is elongate. Brown spots present on the 3rd, 4th, 5th, and 6th rays of the dorsal fin. There are two pairs of barbels. In some specimens tubercles are absent. The disc width is 6 mm, the disc length is 5-6 mm, and posterior barbel length is short. The morphometric data are presented in Table 6.

Coloration

The color is dark gray above, paler below. Dark spots at bases of the 3rd, 4th, 5th, 6th and 7th dorsal fin rays (branched).

Distribution

This species is widely distributed along the coastal drainages of west and southwestern Arabia. It occurs in Wadi Hadhramaut, Wadi Almhaleh between Khamis Mushyt and Abha and a spring in Kheibar City (Figure 1).

Relationship

Garra tibanica shows considerable range in various meristic and morphometric features. For example, the gill rakers on the lower limb of the first gill arch range from 6 to 17 whereas Menon (1964) gave the range as 9-12 (Banister and Clarke 1975).

Trewavas (1941) ^{believed} pointed out that this species is closely related to Garra blanfordii (Boulenger), a species of the eastern watershed of Ethiopia which resembles the Aden forms (and differs from other African species) in its proportions and scales counts and in the position of the anus, which is immediately anterior to the anal fin. Garra lamta resembles

G. tibanica

Garra tibanica in many features, but has larger eyes, the vent is more anteriorly placed and the caudal peduncle is shorter and deeper. Menon (1964) concluded that G. tibanica is most closely allied to G. quadrimculata, but the latter differs in the more anterior position of the anus.

Table 6. Morphometric characters of Garra tibanica.

	n	\bar{X}	Percent of Standard Length	S.D.	Range
TL	4	74.5	----	29.4	46-105 mm
SL	4	60.8	----	22.5	38-86 mm
BD	4	13.0	0.21	4.9	8-19 mm
HL	4	17.0	0.28	6.1	11-24 mm
OL	4	4.3	0.07	0.9	3-5 mm
UJL	4	6.0	0.10	1.8	4-8 mm
DO	4	30.5	0.50	10.1	20-41 mm
BL	4	3.3	0.05	0.5	3-4 mm
AFDL	2	13.0	0.21	1.4	12-13 mm
DFDL	4	13.5	0.22	4.2	9-18 mm
DFBL	4	9.0	0.15	3.7	5-13 mm
CPD	4	6.5	0.11	2.3	4-9 mm
CPL	4	10.5	0.17	2.4	8-13 mm

Abbreviations as on Table 1.

"Within the tibanica complex there are two species from northeast Africa that have some significant similarities with Garra tibanica" (Banister and Clarke 1975). "In Garra makiensis (Boulenger) and Garra ethelwynnae (Menon) the anus is close to the anal fin and the body shape and the color pattern are the same as Garra tibanica" (Banister and Clarke 1975). G. tibanica differs from G. makiensis in the presence of fewer scales in the lateral line (30-36 vs. 30-40). According to Menon (1964) Garra rufa rufa resembles the Garra tibanica complex even though they are well separated geographically. G. tibanica and G. rufa are probably both derived from a primitive Garra which occupied the area from south China as far west as Africa via Afghanistan, Iran, Syria and Arabia (Menon 1964). "Garra tibanica does not closely resemble other Arabian species. Garra longipinnis can easily be separated from G. tibanica by its thin body and very long paired fins, while G. barreimiae can be separated by its mottled pattern and the position of the vent" (Banister and Clarke 1975). Garra arabica, Hora is a dubious species. In the nineteenth century, W. T. Blanford sent fish specimens from Wadi Tiban

drainage at the southern tip of the Arabian Peninsula to the Indian Museum. Hora named a new species, Garra arabica, in 1921, reputedly on the Arabian specimens. Trewavas (1941) mentioned that she examined a cotype specimen of G. arabica and found it closely resembled G. gotyla, an Indian species. Only G. tibanica has been found in several coastal drainages of Arabia. It is possible that the specimens on which the name G. arabica is based did not come from Arabia, but due to a mix-up of specimens at the Indian Museum "G. arabica" may actually be an Indian species. Future collections in the Wadi Tiban drainage would be necessary to shed more light on the validity of G. arabica.

Garra barreimiae Fowler and Steinitz, 1956

G. barreimiae is known only from the drainages flowing from the Alkhdar Mountains to the Arabian Gulf and to the Gulf of Oman. Based on Banister and Clarke's (1975) description, large specimens possess a wedge-shaped snout. The snout bears distinctive patches of horny tubercles. The mental disc is wider than it is long and more constant in form than in G. tibanica. The anus is further from the anal fin in G. barreimiae than in G. tibanica. There are 4 unbranched and 6 to 8 branched dorsal rays. The anal fin has 3 unbranched and 5 branched rays. The lateral line has about 33 scales. Banister and Clarke agreed with Menon (1964) in aligning G. barreimiae with Garra rufa, a widely distributed species between the Mediterranean and the Tigris-Euphrates basin. They described a new subspecies, Garra barreimiae shawkahensis. G. b. barreimiae is restricted to drainages flowing to the Gulf of Oman and to the Oasis of Baraimi. G. b. shawkahensis is confined to the Wadi Shawkah which drains the northwest slopes of the Alkhdar Mountains towards Arabian Gulf.

Garra longipinnis Banister and Clarke, 1975

G. longipinnis Banister and Clarke, 1975. Oman. Jour. Studies, Spec. Rep. (Sci. Results. Oman flora and fauna survey):p. 137.

This species was described by Banister and Clarke (1975) from the village of Saig, Oman. Based on their description the body is thin and the paired fins are long. The mental disc is well developed. There are 4 unbranched and 6 to 7 branched dorsal rays. There are 3 unbranched and 5 branched anal rays. The lateral line has 29 to 31 scales. There are 13-14 gill rakers on the lower limb of the first gill arch. Gill rakers are short and widely spaced. The authors suggested the close relationship between this species and Garra barreimiae based on the development of the mental disc, the rounded shape of the snout in side view and a similar anus - anal fin distance (4.6% SL).

FAMILY CYPRINODONTIDAE (TOOTH-CARPS)

This is a very large family, commonly called "tooth carp." Typically small fish (<100 mm). Upper surface of the head is usually flattened. Mouth is terminal, specialized for feeding on surface. No barbels. No adipose fin. Swim bladder without duct. Fins spineless.

Aphanius dispar Rüppell, 1828

Lebias dispar Rüppell, 1828. Atlas Zu der Reise im nördlichen Afrika, 4. Fische des Rothen Meers:66.

D I-7 or II-7, A I-8 or II-7, L. L. 26-28, p. 13-14.

93 specimens were collected July 1977, SL. 30-60 mm. All specimens from Red Sea and Gulf drainages. This species appears to be the most widely distributed species in Arabia (Figure 1). This distribution is due to the salinity tolerance of Cyprinodont fishes which allow movement through the sea. Members of this species are sexually dimorphic. Specimens rarely reach 80 mm. In the adult male the dorsal fin is twice as high as that of the adult female. Aphanius dispar exhibits considerable variation in the specimens examined. They have 13-16 gill rakers on the anterior side of the first arch and 15-23 gill rakers on the posterior side of the first arch. There are 26-28 scales in the lateral line. Dorsal fin has two unbranched rays and eight branched rays. Anal fin has eight rays. In the male the dorsal profile is arched. Pectoral fin overlaps pelvic fin, pelvic overlaps anal fin. Fins are long and pointed. Dark blue speckles occur on the dorsal and anal fins of the male. Male is brightly colored, brown to dark blue, with numerous iridescent, blue-silver blotches in rows on the flanks and weak brownish transverse bars above the caudal peduncle. Dorsal and anal fin with silvery blotches and dark spots. Pectoral and pelvic fins are yellow. Female gray with a bluish-silver sheen. Numerous transverse bars on the flank. Fins are small and rounded. In all specimens teeth are tricuspid. Preoperculum black. The stomach is well developed. The presence of this species in the eastern regions and Al-kharj has not been mentioned before.

FAMILY: POECILIDAE

Viviparous, more than 25 genera in North and South America. Anal fin of the male produced, its 3rd, 4th and 5th rays modified into a copulatory organ.

Gambusia affinis Baird et Girard

1) Heterandria affinis Baird et Girard, 1853.

2) Heterandria patrucilis Baird et Girard, 1853.

3) Gambusia affinis affinis Lindberg, 1934, p. 357.

D 6 (last two rays taken as one), A 8-9, L. L: 28-30.

Two specimens SL 34 and 36 mm were collected from one spring in Al-Kharj City (Figure 1). G. affinis is a small fish, seldom exceeding 60 mm. The gill rakers number 12-14. The dorsal fin has six rays. The lateral line scales range from 28 to 30. The genus Gambusia has been artificially introduced throughout the world to control malaria. Among the collections made in the summer 1977, we found this genus in one spring in Al-Kharj City. This is the first time this species was discovered in Saudi Arabia. There should be general awareness in Saudi Arabia concerning the potential danger that introductions of exotic species have for native species or for disruptions of ecosystems. Thus, it is important to complete a comprehensive survey of Arabian fishes to document the occurrence and status of all native species in order to better protect them from habitat destruction and non-native fish introduction. The native "top minnow," Aphanius dispar, can probably act as an effective biological control for mosquitos. Saadati (1977) pointed out that G. affinis had replaced Aphanius from much of the range in Iran. Al-Daham and others et. al. (1977) discussed interaction between Gambusia and three species of Aphanius in southern Iraq. In the future, we urge that the native species should be used for such introduction.

DISCUSSION

totals
93 Aphanius
as
150

About (600) specimens representing eight species were collected in 1977 from 28 localities of eastern, northwestern and southwestern Saudi Arabia. The most common and ubiquitous species, Aphanius dispar, made up most of the total number of specimens.

Our collections made in 1977, although restricted to Saudi Arabia, represent the most extensive sampling of freshwater fishes yet made from the Arabian Peninsula. We found all of the species described by Banister and Clarke plus three new species of the genus Cyprinion (C. mhalensis, C. nemus, C. niger).
(in Saudi Arabia (C. logispinnis Oman))

Although no fish collections have yet been made in vast regions of Arabia and much is yet to be learned, some general conclusions can be made. It appears that the original African fish fauna existing up to the time of the initiation of the Red Sea rift in the Miocene were completely eliminated. Firtually all species of primary freshwater fishes now known in Arabia are endemic species. This fact indicates long isolations.
except one
except C. watsoni - microphthalmum

The genus Cyprinion is of Asiatic origin and is represented by one non-endemic and four endemic species. The four endemic species appear to be more closely related to each other than to any other living species in the genus. The non-endemic species (C. watsoni) of general Asiatic distribution is assumed to have crossed the Arabian Gulf from Iran in the late Pleistocene time when the Gulf was a freshwater lake due to a low sea level.

The genus Garra, also of Asiatic origin, crossed the Arabian Peninsula to become established in northeast Africa. Garra is represented by three, possibly four (depending on validity of G. arabica), endemic species. There is a question concerning Garra tibanica as an endemic Arabian species. Menon (1964) recorded G. tibanica from Somalia. There is such variability and diversity in Menon's "tibanica complex" that we consider the identification of Somali specimens as G. tibanica, at best, doubtful in considering the time of isolation.

The three endemic Arabian species of Barbus suggests two origins, Barbus apoensis and Barbus exulatus, derived from a Jordan River Barbus canis-like ancestor, and Barbus arabicus, derived from a large-scaled Barbus ancestor native to northeast Africa. Aphanius dispar, because of its ability to disperse through seawaters, does not represent ancient relict populations divergent from the parent species. The present distribution of Aphanius is assumed to be of late Pleistocene origin, when present isolated, internal basins had direct outlets to surrounding seas.

In Arabia, no fish collections have yet been made from the Ar-Rumah - Al-Batin, Euphrates and As Sirhan basins. The other basins have not been extensively collected. Much is yet to be learned on the freshwater fishes of Arabia.

Ichthyological studies can be of critical significance for interpretation of climatic and hydrographic history of the country. Also, freshwater fish can become a more important part of the Saudi Arabian economy by increasing the supply of protein, by providing recreational and esthetic values and perhaps as a biological control agent for vegetation problems and disease vectors. However, introductions of non-native species without suitable planning and evaluation of all possible ramifications can cause ecological catastrophies.

Utilization of native fishes to serve national interests should be given priority. A continuation of the present study is necessary to complete the documentation of species, their distribution and habitats before extinction caused by water development projects occurs. Our study on the freshwater fish fauna of Saudi Arabia emphasizes the need for a national awareness to preserve all native plants and animals and develop an environmental conscience to protect Saudi's biological heritage.

The prophet Muhmmud urges the nations to be merciful and helpful to all of God's creatures. Thus, the development of an environmental conscience has a basis in Islamic religious and cultural heritage. Abu Huraira tells us that Allah's Apostle said: "While a man was walking on a road, he became very thirsty. Then he came across a well, got down into it, drank of its water and then came out. Meanwhile he saw a dog panting and licking mud because of excessive thirst. The man said to himself, "This dog is suffering from the same state of thirst as I did." So he went down the well (again) and filled his shoe (with water) and held it in his mouth and watered the dog."

Allah thanked him for that deed and forgave him. The people asked, "O, Allah's Apostle! Is there a reward for us in serving animals?"

He said, "Yes, there is a reward for serving any living being."

The original Arabic text is as follows:

حدثنا إسماعيل: حدثني مالك، عن
 محمد بن موك، عن أبي بكر، عن صالح بن شعيب،
 عن أبي هريرة: أن رسول الله صلى الله
 عليه وسلم قال: بينما رجل يمشي بطريقه اشتد
 عليه العطش، فوجد بئراً فنزل فيه
 فشرب، ثم خرج فإذا كلب يلهو يأكل
 الثرى من العطش، فقال الرجل: لقد
 بلغ هذا الكلب من العطش مثل الذي
 كان بلغ بي، فنزل البئر فملا خفه،
 ثم امسكه بفيه فغرس الكلب، فشكر لله له
 فغفر له.
 قالوا: يا رسول الله، واره لنا في البئر
 أمراً؟ فقال: "في كل ذات كبد رطبة أجر*"

*Sahih Al-Bukhari, 2nd edition, 1977, Vol. VIII, Hilah Yayinlari,
 P.O. Box 448, Ankara, Turkey.

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